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A BUREAU OF STANDARDS FOR INDIA

II

AS we have pointed out, in our previous issue of *Current Science*, industrial standardization, which started with the introduction of technics and scientific methods in industry, was accelerated by the economic pressure in producing countries and by the way in which standardization provided an easy remedy for some of their difficulties. Standardization by companies (of their products and processes of manufacture), which started in the latter half of the last century, was extended into standardization by groups or associations towards the beginning of this century. Experience showed, however, that in order to obtain full benefit from the process standardization must be undertaken on a national basis. At present not only is standardization in industrial countries being introduced on an inter-industrial basis but attempts are also being made to bring about international co-operation in the field as far as possible.

The main interests affected by the introduction of standardization in industry are: (1) Producer, (2) Distributor, (3) Consumer. The Government of the country being generally the largest consumer of goods and being responsible for the economic development of the nation cannot of course be left out. The fact that these interests are closely interlinked is not always easily recognised, the consumer does not usually recognise the benefits of standardization and considers it as a problem for the producer. The consumer's engineer very often assumes an uncompromising attitude by specifying

unique equipment or machinery, and is unwilling to sacrifice the latitude of his wide choice in favour of standardised goods for the sake of what he thinks to be the benefit of the maker. On the other hand a producer who has secured precedence in the market may sometimes run after the fallacious idea that he can bind down the customers by supplying them with unique or special types of products which are not available elsewhere. Thus there is a possibility of lack of understanding not only between users and makers but also between makers themselves. The chief difficulty of the problem lies in setting up machinery that would harmonise the various interests and operate for the common good. One obvious solution would be to set up an agency controlled by the Government to deal with the problem of standardization in industry. But it must be remembered that the technical and the scientific world is becoming so complicated and the controlling factors in industry so diverse that to come to any impartial decision which could claim adherence from all, it is but expedient that all interested should have a voice in framing it. In industry standardization is a co-operative movement and cannot be established by law without violating its usefulness considerably. A Government agency with its powers circumscribed by the government restraint and administrating with the help of inelastic legislation is not only likely to fail but may prove a hindrance to the progress of industry. Experience in other countries has shown that a fully democratic organization representing all legitimate interests and claiming no authority except by the merit of its decisions is best able to rally co-operation on all hands and gain public confidence. Added Government recognition would of course bring the security and dignity that are indispensable.

The function of such a body is to simplify, modify and unify the needs of the producer and the consumer with a view to increase the efficiency of production on one hand and ensure the safety and security of the consumer's interest on the other. The work to be done in this connection can be classified under the following heads:—

1. Standardization of quality: this consists in fixing, in definite or measurable terms, such properties of materials as are pertinent to its quality. Uniformity of composition, mechanical strength, etc., may be quoted as instances.

2. Standardization of performance: These specifications lay down in terms which are susceptible to measurement the minimum factors or requirements involving net efficiency, durability, and safety of an appliance under test or working conditions. In the case of electrical machinery the specifications include speed, output, power factor, rise of temperature and several other factors.

3. Standardization of practices: Formulation of codes or regulations regarding construction, installation, maintenance, operation or testing of plant and apparatus with a view to secure safety, uniformity and continuity in working.

4. Simplification: This is intended to bring about uniformity in types, sizes or grades of manufactured goods and to reduce such types, etc., to an optimum number with a view to minimise the waste involved in the production of unnecessary variety of goods, and to secure interchangeability of appliances and component parts.

5. Standard testing: Testing of typical manufactured goods is done with a view to assess the quality of such goods impartially and help the industry by the knowledge so gained in further development and in advertisement.

The outline of the work as stated above may be sufficient to indicate how closely standardization is connected with the scientific development of industry. When organised within healthy limits it is one of the outstanding factors that controls the economic progress of industry. Care must however be taken to guard against premature standardization or over standardization. The general tendency amongst the manufacturers is towards achieving standard requirements more than making new improvements and also towards using all ingenuity in achieving these results by the most economical methods. Secondly forces towards maintaining the *status quo* in manufacturing processes are invariably supported by established custom and vested capital. Standardization therefore if carried out without sufficient safeguards may impede progress or even lead to sterilisation. To derive maximum advantage from standardization in industry it must be based on liberal principles. The following points may be worth mentioning in this connection:

1. Standardization should be based on voluntary co-operation between the various interests.

2. To reach full effectiveness it must be organized on an inter-industrial basis.

3. The number of standards set up should be a minimum and should not change unless a definite improvement on the old one is attainable.

4. Standards must be open to critical surveillance and must be subject to review and revision whenever these are found necessary.

5. As far as possible attempts should be made to level up standards. No recommended standard should prove a hindrance to progress.

6. Standards should be based only on reliable information or observations regarding pertinent factors. Only such factors as are essential to obtain the desired effect should be made mandatory. Freedom in all details and in methods of achieving effects should be given to individuals.

7. If possible all specifications should be made to pass through an experimental stage before they are finally accepted.

8. As far as possible the initiative for a new standards specification should come from all parties interested in it and not from a standards organization.

9. Codes and regulations involving technical details though sometimes national in character should be handled in an advisory capacity.

Organised on these lines standardization has proved a great help to industry, it promotes precision in industry and puts it on a scientific basis, it clarifies the undertaking between the maker and the user and promotes fair dealing.

To the producer, it saves the waste of time and material involved in unnecessary diversity of patterns and sizes of ordinary commodities. It gives him an idea of what the customer expects and enables him to level up the excessive ups and downs in the

market demand by spreading out his production over the whole year. Thus it incidentally helps in reducing seasonal unemployment in industry, it prevents unfair competition amongst producers and puts them on the same level without eliminating the possibility of specialised production, it helps to promote truthful advertising. To the distributor it spares the necessity of keeping large stocks representing so much locked-up capital much of which can never be realised. To the consumer it means less cost, better quality, prompt delivery, interchangeability of appliances, full guarantees from the manufacturers and an immunity from the risk attendant on a novel design. It is a guide to purchase and a reliable basis for comparison of standard tenders. If a transformer of a certain capacity is needed all that the consumer need do is to indicate that the performance of the appliance shall be in accordance with certain known specifications; he receives quotations for a machine of the same guaranteed performance and chooses the cheapest.

To what extent standardization and particularly simplification can be introduced in industry, and to what effect, can easily be seen if we turn our attention to any of the industrial countries, the process for instance has greatly contributed towards the success of the American Motor industry. According to the General Motor Co. of America the 13,000 minor components of which a car is built up are now reduced to only 2,000.

In India industrial activity so far is small and is limited to a few fields such as textiles, cement, electricity, engineering, etc., etc., but judging from the trend of events during the past few years it would appear that the country will soon witness an industrial revolution. Whether this revolution comes sooner or later it can be said without any hesitation that an organisation to guide the technical and industrial practices in the country is a necessity and will surely be a step in the right direction. We may state here the following reasons:

1. At present the specifications followed in India are mostly British. Besides these, specifications are also issued by Government and semi-government bodies to suit their own requirements. We think it is time these various specifications are co-ordinated and placed on a national basis to suit the requirements of the growing Indian Industry.

2. If co-ordination and standardization is introduced in some of the existing industries such as the electrical supply industry it will be possible to create a definite market for a limited variety of goods. It need not be pointed out that this would be a great incentive to the initiation of new productive industries.

3. The necessity of a recognised place which would test the quality and performance of industrial products and issue necessary certificates is being increasingly felt. The Government Testing Laboratory at Alipore undertakes such work but its activity is so far limited.

We therefore suggest that a central organisation to consider questions relating to standardization in Indian industry and to take the necessary steps to promote such standardization is a necessity. We may also put forward some tentative proposals for such an organisation.

The aims of the organisation should be (1) to co-ordinate the existing resources to undertake work connected with standardization and to create opportunities for various industries interested in such work to come together and co-operate in the work. (2) To study and co-ordinate the industrial standards followed in the country, to modify the old ones or formulate new ones in the light of the needs of the growing Indian Industry. (3) To work in co-operation with existing research laboratories in India and to secure for the industries the necessary aid to standardize their products. (4) To promote knowledge of national standards in this country and abroad and to act as an authoritative channel of co-operation in international standardization work.

The organisation should be thoroughly representative and may be formed of representatives from (1) leading industrial and commercial concerns and organisations. (2) Research institutions and laboratories. (3) Engineering and commercial associations. (4) Central Government (Department of Commerce, Communication and Central Stores). (5) Provincial and state governments which are interested in the work. The organisation may not have a laboratory of its own; work connected with securing technical data or carrying out investigations to base its recommendations upon can in the initial stages be undertaken in co-operation with public institutions. We may suggest that the Government Testing Laboratory, Alipore, which is already interested in this type of work would co-operate. If necessary some additions should be made to enable it to undertake work of a specialised nature. Standard testing could also be carried out at the same place.

The actual working of such a body should be on the same lines as those of the British Standards Association. A new specification or modification is sponsored by any party represented on the body, after due consultation and agreement with other interests involved. A special expert committee consisting of representatives of all legitimate interests is then formed to study and formulate the proposals and recommend them to the Central Board. The Committee has wide powers and its decisions are accepted except in cases of dispute. Wide publicity is given to the proposals during the committee stage and the next stage when the proposals are published as tentative specifications. Any comments or criticism are carefully considered. The specifications are finally incorporated when they are accepted by all and have proved their suitability.

Expenditure involved in such an organisation is small (only on office accommodation, printing and few experts) and can be met by contributions from commercial bodies represented on the organisation and the various governments.

NON-LINEARITY IN QUANTUM MECHANICS*

BY

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IT is perhaps the most fundamental principle of quantum mechanics that the system of states forms a linear manifold in which a unitary scalar product is defined, and the linear character of the wave function is the superposition principle which is at the basis of quantum mechanics. Developments during the last few years have however given an indication that one may have to admit the possibility of a future non-linear character of quantum mechanics. The first indications of non-linearity came from the positron theory, and later the avowedly non-linear theory of Born was devised to meet the difficulties of infinite self energy in quantum electrodynamics. Still more recently the question of interaction of mesons with nuclear particles appears to suggest that this interaction may be of a non-linear type.

It is instructive to notice that the two fundamental difficulties of quantum mechanics, *viz.*, the question of divergences, and the problem of the elementary particles can be traced in essence to this question of linearity *vs.* non-linearity, the main difficulty in the latter case being the conception of unification of the different wave equations of the elementary particles, light and heavy, into one comprehensive theory if it is to be linear.

Let us look a little more closely at the type of non-linearity that arises in positron theory, and its connection with the non-linear field theory of Born. The simplest application of the former theory is to the adiabatic insertion of an external field into a "vacuum" which induces a sort of vacuum polarisation, in other words, a charge distribution equivalent to the creation of pairs. The next simple application is the case where the external field is so weak that only first order terms in the field strengths and their derivatives need be retained in the perturbation calculations. In this approximation additional terms appear in Maxwell's equations equivalent to saying that Coulomb's law breaks down for distances less than the Compton wave-length. For higher approximations the corresponding field equations are no longer linear, and the superposition principle no longer valid. This deviation from linearity also gives rise to the phenomenon of scattering of light by light which is explained on the basis of the creation of pairs in intermediate states. These features of the positron theory appear to have a close parallelism with the non-linear field theory of Born. In fact, the concept of vacuum polarisation is inherent in the nature of the latter. Further all calculations made on the assumption of the non-linearity in positron theory show that the field equations can be derived from a Lagrangian which, remarkably enough, has the same form as in Born's unitary theory. A quantitative comparison of the two theories shows that the critical field strength of the positron theory is numerically equal to the field strength on the classical Lorentz theory at the boundary of the electron, and this is also the stage at which the feature of non-linearity set in. It is also necessary to observe a striking difference between the two theories. In the theory of the positron negative and positive masses play symmetrical roles while Born's theory does not envisage negative mass even abstractly. Now, Pauli has recently shown on very general considerations that there is an intimate relationship between spin, and definiteness of charge or energy density. Thus the definition of a definite particle density (4-current) which transforms like the components of a 4-vector is not possible for integral spin, and a positive definite energy density, and also a positive definite total energy are not defined for half-integral spin. These, however, are not positive statements since they do not say that for integral spins there is a definite energy density, and for half-integral spins a definite charge density. In fact, this is no longer the case for spins greater than 1. It is only in the case of the small spins 0, ½ and 1 that such positive statements could be made. Thus the spin ½ is characterised by the fact of the possibility of a definite charge density, and spins 0, 1 of definite energy

* Opening Address at the Symposium on Quantum Mechanics held during the Indian Science Congress Session, Madras, Jan, 1940.

density, and thus these spins are distinguished from all other higher spins. As is well known, Born's theory does not explain the spin of the electron correctly giving integral eigen values for the spin operator. This fact which is in consonance with the energy density being positive appears as a consequence of the fundamental assumption of non-linearity introduced in the theory. On the other hand, the positron theory which explains spin correctly has also non-linear features which appear to have been forced into the theory. Thus, in spite of the similarities between the two theories, it looks as if non-linearity as a fundamental physical principle does not perhaps really go very deep being more in the nature of a mathematical device.

As another example of a theory wherein non-linearity appears as a secondary feature might be mentioned the recent classical theory of the electron given by Dirac. This theory retains Maxwell's equations as they are, *i.e.*, the field equations are linear, and the infinities are avoided by a sort of subtraction formalism of the type used in the positron theory, getting the finite mass of the electron as the difference between the infinite negative mass at the centre, and the infinite positive mass of the surrounding Coulomb field. The equations of motion of the electron in the electromagnetic field, however, come out non-linear in the theory, giving an example of non-linearity of a derived or secondary type.

We might now consider the non-linearity that arises in the theory of the meson in connection with the interaction of mesons with nuclear particles. The meson theory originally proposed by Yukawa for the explanation of the exchange character of nuclear forces is based on the heuristic assumption that nuclear forces can be described by some sort of linear field. The theory has been further refined by the introduction of the vector formalism, but the field is still linear differing, however, from the Maxwell field in two important respects, *viz.*, the meson field itself is charged, and is characterised by a "meson charge" g_1 and a "meson dipole moment" g_2. Thus taking into consideration the mass of the meson we have three essential differences between the theory of the electron and the meson. When the meson theory is applied to the interaction with nuclear particles, as for example, to collision processes with large cross-sections, it appears to break down for distances less than $1/\lambda$ ($= \hbar/\mu c$; μ = mass of meson). There appear terms in the interaction which increase with increasing energy. Connected with the same behaviour of the interaction is the fact that many other effects as, for example, the perturbation of the self energy of the proton diverge more acutely than in ordinary radiation theory. This has led some theoretical Physicists to doubt the correctness of the fundamental equations even for mesons of energy comparable with their rest mass, and to take the position that these facts set a limit to the applicability of quantum mechanics suggesting that the right interaction may be of a non-linear type. However the recent work of Bhabha on the classical theory of neutral mesons, and some as yet unpublished work by the same author on the classical theory of point dipoles seem to suggest that these difficulties are really spurious and arise because of the fact that radiation reaction is not properly taken account of in quantum mechanics. In any case, even if such a non-linear feature becomes inevitable, we should observe that the position regarding non-linearity here is different from that in quantum electrodynamics where the deviation from linear laws are purely of a theoretical nature, and cannot be verified experimentally. Thus all radiation effects of an electron could very well be treated by a first order approximation theory, and there would be no experiments contradicting such a theory. Here the behaviour of mesons in traversing matter provides direct experimental tests for the interaction in question, *i.e.*, the non-linearity is of a determinable type.

Mention might also be made here of another attempt at a non-linear theory based on the idea of a new universal constant like an absolute length or momentum or field strength. Basing his considerations on the fact that one has to rely only on theoretic grounds for introducing non-linearity, Born has recently introduced his principle of reciprocity. According to this, the only natural and unique way of introducing non-linearity into a field theory is that used by Einstein in his theory of gravitation, namely, the postulate of general invariance which leads one to consider space-time as "curved". But Einstein's theory has to do with very small curvatures imperceptible in the region

of laboratory dimensions. It is also clear from the smallness of the gravitational constant that cosmological curvature has nothing to do with atomic effects. These latter are bound to be extremely small, of the order r_0. But small r_0 means large momentum $b = h/r_0$. Born's principle is that the domain of elementary particles has to be considered from the standpoint of momentum-space in which a non-linear geometry with small curvature reigns. The curvature equation should contain solely r_0 and b (or r_0 and h) but not the gravitational constant.

The question whether the linear or non-linear character of a field theory is related to the question of derivation of the equations of motion from the field equations alone might now be examined. For instance, in the well-known Helmholtz theory of vortices in a non-viscous fluid the motion of line-singularities is actually determined by the partial differential equations alone which are there non-linear. In the gravitational theory where also the field equations are non-linear the recent "approximation method" of Einstein-Infeld-Hoffmann shows that such a thing is also possible. On the other hand, in the non-linear theory of Born the equations of motion are not determined by the field equations alone.

Coming to linear field theories we might notice that in ordinary Maxwell's equations in which electrical particles are regarded as point singularities, the motion of these singularities is not determined by the linear field equations. On the other hand, in the recent Dirac theory of the electron the equations of motion, though themselves non-linear, follow immediately from the field equations which are linear.

We have described a number of non-linear theories in some of which non-linearity enters as a fundamental factor, and in some others as a secondary feature. Again in some it is purely of a theoretic origin and in others of a type which can be decided by observation. As regards non-linearity as a principle in theoretical physics it is difficult to say anything in general. Judged by the principle of simplicity linear laws appear to be the most suitable ones, and moreover they have the advantage of uniqueness.

SOIL EROSION CAUSED BY WIND

BY

R. MACLAGAN GORRIE, D.Sc.

SOMEWHERE above the dust, gloom and grit of the dust-storm, the sun is shining. For want of adequate protection on some land surface, the wind has whipped up the loose soil and carried it many miles to make life hideous for the dwellers in some distant city. Somewhere it will come to rest. Somewhere wind-transplanted seeds may lodge and grow, but the sower will not be the reaper.

We have been asked to explain the significance for India of wind erosion. Roughly one may say that wherever there are dust-storms there is wind erosion; a fairly large part of India is suspect, but without a detailed survey of soil behaviour actually under the stress of exceptionally high winds, it is very difficult to give a concise picture of the damage which may be occurring in different parts of India.

In soil erosion caused by water, it is the exceptionally severe storm spread over many hours, but with interspersed intervals of torrential downpour, which causes infinitely more damage than weeks or months of ordinary rain showers. So also in wind erosion, it is the sustained and exceptional storm which does the greatest damage, but here the phenomenon is of very high wind following weeks of drought, and possibly assisted by widespread ploughing operations or forest fires or excessive grazing, all of which leave powdery soil exposed to "dust devils" which carry it into the upper air.

Erosion by water and by wind is frequently found acting in turn on the same patch of ground, but roughly speaking, water erosion is a serious phenomenon on slopes of more than 3 per cent. whereas wind erosion is more prevalent on flat or slightly undulating surfaces. Nature sees to it that where water cannot punish man for his destructiveness and poor husbandry, the wind can do so. A land surface typical of wind erosion is carved out in hummocks of soil, the crest of each rise being built

round some deep-rooted vestige of the previous plant cover. Round each of these centres the wind has picked away the exposed soil until quite deep channels have been formed with scallopped markings on the sandy surface reminiscent of wave action ripple markings on a sea beach. Such a landscape is well seen a few miles north of Campbellpur in the Attock District. In many places where a typical wind erosion landscape has not developed, however, wind erosion may nevertheless be serious, as can be judged from the way wind borne sand and powdery grit accumulates behind Euphorbia and other live hedges. Mr. J. A. Wilson of the Forest Service recently quoted as examples the land along the Coimbatore–Bolanpatti and Coimbatore–Mettupalyam roads, and observant readers can doubtless add their own examples from their own country-side.

The loss from wind erosion is an even more insidious one than in water erosion, for the lightest particles in the soil are inevitably the ones you want to keep, the infinitely small grains of manurial material and partially leached salts. The factors which contribute to the severity of wind erosion are bare earth surfaces of pulverised soil, and a high wind with an unobstructed stretch for it to operate in. 'Eliminate any of these and the wind cannot collect a large load. First, then, keep the plant cover intact even if it is only an incomplete carpet of bunch grasses. Secondly, where ploughing is to be done, keep your fields under diversified crops in strips set at right angles to the prevailing wind. The actual velocity of the wind cannot of course be controlled, but by ridging the ploughed soil in plough land, soil drift can be greatly reduced. Thirdly, make full use of nature's own prescription by growing shelter-belts of trees and tall grasses.

Possibly the closest study of shelter-belts has been made in Russia, where recent planting under the second Five Years' Plan has amounted to 865,000 acres of shelter-belt, a truly gigantic scheme vying in scope with the American Great Plains Shelter-belt project. The efficiency of these shelter-belts across the wide and wind-exposed plains has been thoroughly tested and measured. They cause a marked increase in productivity in each field in a strip up to 20–25 times the height of the trees in the belt, even when the belt consists of a single line of trees. They not only reduce the extreme severity of the wind and stop it from transporting soil, but the temperature and aridity extremes are reduced so that the crop ripens more regularly. In snowy areas the moisture added to the ground by the deep and regular snow beds in rear of each belt is of the greatest value and contrasts markedly with unprotected land where the snow beats along in a blizzard and eventually leaves much of the ground frozen, uncovered and dry. Similar results are also reported from Canada and Hungary.

Soil is most in danger from wind when it is pulverised and broken down. When its natural aggregation into a crumb structure has been preserved and encouraged by good methods of husbandry, the danger is greatly reduced. When a large flat open area has been badly cultivated and starved of manure so that the crumb structure has collapsed into a friable powder, the wind can produce chaotic damage in a very few days or even hours. The pulverised soil is lifted bodily from the surface of the fields and dumped around obstructions such as hedges, buildings, roads and railways where it is least welcome. The vagaries of such damage are often hard to understand, for the top few inches of fertile soil may be removed from one man's fields while another's field near by is buried under a load of sterile sand. Soil thus lifted up is itself a potential destroyer, for it has a sand-papering effect upon any vegetation standing in its path, and in very severe dust-storms the vegetation may be stripped or browned off almost as if frost or hail had destroyed it.

LETTERS TO THE EDITOR

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Magnetism of Phosphors

A study of the magnetic susceptibility by the Curie balance of a few commercial samples of phosphorescent powders indicates an increase of diamagnetism when the powder is rendered luminiscent. As long as the composition of the phosphors remains unknown, the observed variation may be attributed to the existence of some paramagnetic components, whose susceptibility depends on temperature. With the view of eliminating the uncertainty regarding the composition, the calcium "sulphide"—bismuth phosphor was prepared from chemically pure ingredients. 7 gm. of sulphur and 10 gm. of calcium oxide were ground together and heated to redness for about 15 minutes in an electric furnace. 5 gm. of this calcium "sulphide" was mixed with 0·25 gm. of sodium sulphate, 0·15 gm. of sodium tetraborate, 0·10 gm. of calcium fluoride and 0·0012 gm. of bismuth; the mixture, after heating to bright redness for about 25 minutes, yielded the CaS-Bi phosphor which phosphoresces with a blue colour when exposed to light. In fact the luminescence is so strong that the spectrum of the phosphorescent light is clearly visible in a direct vision spectroscope.

A magnetic study of this phosphor has revealed that the process of the decay of phosphorescence can be followed from observations on the variation of susceptibility during the decay. Fig. 1 gives the variation with time of the

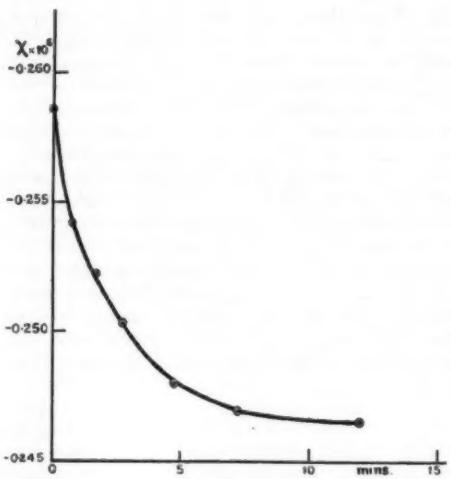

Fig. 1

The variation of magnetic susceptibility of CaS-Bi phosphor during phosphorescent decay

susceptibility of the CaS-Bi phosphor initially illuminated strongly. As the materials utilised in the preparation of the phosphor are all diamagnetic, the observed increase of diamagnetism while luminescent cannot be ascribed to a temperature effect. An independent test has shown that the temperature effect on the magnetism of the powder is inappreciable. According to the view put forward by Lenard,[1] the phosphorescent centre consists of the atom of the heavy metal (Bi) attached to a sulphur atom in the ringlike arrangement of the alkaline earth sulphide (CaS). The increase in the observed diamagnetism while luminescent is on this basis explicable as arising from the larger electron orbits which circumscribe the phosphorescent centre on irradiation; our results therefore lend support to Lenard's view regarding the mechanism of phosphorescence. The earlier results of Rupp[2] cannot however be reconciled with the expectations of the Lenard theory.

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H. S. Venkataramiah.

University of Mysore,
Central College, Bangalore,
April 11, 1940.

[1] Lenard, *Ann. der Physik*, 1910, **31**, 641.

[2] Rupp, *ibid*, 1925, **78**, 505. (*Vide Physical Principles and Applications of Magnetochemistry* by Bhatnagar and Mathur, p. 158.)

A New Band λ 2963 of the *OD Molecule*

In a previous letter[1] the rotational structure of the (2,1) band λ2916 of the OD molecule has been reported. Further work on the emission band spectrum of heavy water has revealed the existence of a new band with its head at λ2963, showing doublet P, Q, R branches, characteristic of the electronic transition $^2\Sigma^+ \rightarrow {}^2\pi_{inv}$. The values of the rotational term differences and the calculated constants indicate that the band corresponds to the vibrational states $v' = 3$ and $v'' = 2$. Attempts are being made to detect the analogous (3,2) band of the OH molecule, which does not appear to have been identified so far in spite of numerous investigations on the emission spectrum of ordinary water vapour.

The calculated constants for λ2963 referred to above are $B_3' = 8{\cdot}09$, $B_2'' = 9{\cdot}31$.

The wave numbers of the lines $Q_1(1)$ and $P_1(1)$ are 33702·8 and 33686·9 cm.$^{-1}$ respectively. The analysis has led further to estimate the vibrational constants for the lower electronic state of the OD molecule. From the data for the bands (2,0), (2,1) and (3,1), (3,2) the intervals $\Delta^{v}_{\frac{1}{2}}''$ and $\Delta^{v}_{1\frac{1}{2}}''$ have been found to be 2632·0 and 2544·5 cm.$^{-1}$ respectively. Hence it is easy to deduce the following values for the vibrational constants,

$$\omega_e'' = 2719{\cdot}5,\ x_e''\omega_e'' = 43{\cdot}75.$$

The mass ratio of the hydrogen isotopes estimated from ω_e'' (OD) and ω_e'' (OH) is obtained as $\rho = 0{\cdot}7281$.

Details of the rotational structure will be published shortly.

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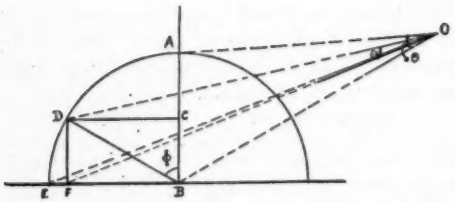
Andhra University,
Waltair,
April 8, 1940.

[1] *Curr. Sci.*, 1940, **4**, 172.

Variation of Intensity along an Electron Reflection Ring

In examining the structure of a polycrystalline surface by electron reflection, the patterns obtained consist of rings in the form of semicircles. The reflected rays lie on a cone with the incident beam as the axis. The electrons reflected along a generator of this cone which lies in the plane of incidence, leave the material by the shortest path; while the electrons moving along any other generator have to travel over a longer distance. Those electrons which travel over a longer distance in the material are absorbed more than those which have a shorter path in it. Thus we can see that the intensity of a ring in a reflection pattern—which is merely the section of cones

of reflection—will be maximum along the planes of incidence, and will diminish as we go further and further away from this plane.



In the figure ADE is the ring, BAO the plane of incidence, DO any ray making an angle DBA = ϕ, and the angle DOF = θ, the angle of emergence of the ray OD. Since OA lies in the plane of incidence, the angle BOA, the angle of emergence of the ray OA is equal to the glancing angle θ. Further X and Y are the paths travelled respectively by the central ray OA and the ϕ-ray OD, after reflection at P within the material. If we assume that the reflecting block has a flat surface we get from the geometry of the figure

$$\sin \theta_i = \sin \theta \cos \phi$$

and $$y = x \sec \phi.$$

It is quite natural to suppose that the electrons like X-rays obey an exponential law of absorption. On this supposition we get

$$I_\phi = I_{\phi_0} e^{-\mu x (\sec \phi - 1)}$$

where I_{ϕ_0} is the intensity for $\phi = \theta$. For a definite specimen and a particular ring, x would be fixed and we may write $\mu x = A$, a constant.

In column two of the table are given the values of I_ϕ for different values of ϕ and A, these are calculated on the assumption that I_{ϕ_0} = 100 in each case. Column three gives the relative intensities obtained with a microphotometer, here also for comparison the values are expressed with $I_{\phi_0} = 100$. The specimen used to produce the pattern was a polished piece of silver etched to give rings. In this case the best agreement between the observed and calculated values of I_ϕ is obtained for A = 1. A qualitative consideration of the penetrating power of the fast electrons also shows that A or μx should be of the order unity for 30 K.V. electrons.

TABLE

Angle	I_ϕ Calculated			I_ϕ Observed
	A = 1	A = 3	A = 10	
0°	100	100	100	100
1°	100	100	100	100
15°	97	90	70	98
30°	85	63	22	87
45°	66	29	2	68
60°	37	5	negligible	34
75°	6	negligible		5
80°	1			negligible
85°	negligible			

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The Mechanism of the Persulphate-Alkyl-Iodide Reaction

THE persulphate-alkyl-iodide reaction was found by us to be kinetically of the first order with respect to the alkyl iodide.[1] However, the reaction is not unimolecular, as varying the concentration of either of the reactants produces a corresponding variation in the reaction rates. The persulphate acts not only as an oxidising agent, but also as a catalyst, the potassium ions exerting a primary electrolyte effect.

This reaction cannot be analogous to the reaction between potassium persulphate and

potassium iodide, which is bimolecular. Also, the nature of the primary salt-effect in these two reactions is not similar. Any formation of iodoso or iodoxy compounds is out of consideration as in such a case the reaction would be of the second order. In order to explain the first order mechanism, the alkyl iodide could be supposed to primarily dissociate in one of the following three ways:—

$$\left.\begin{array}{ll} 1. & C_2H_5I \longrightarrow C_2H_5 + I \text{ (radical)} \\ 2. & C_2H_5I \xrightarrow[H_2O]{} C_2H_4 + H^+ + I^- \\ 3. & C_2H_5I \longrightarrow C_2H_5OH + H^+ + I^- \end{array}\right\} \text{(slow)}$$

After the dissociation, the iodine radical or ion may be oxidised to molecular iodine, which would be a faster process, thus:—

$$I \text{ (radical or ion)} + \overline{\overline{S_2O_8}} \rightarrow \overline{\overline{SO_4}} + I_2 \text{ (fast)}$$

It is also possible that oxidation of the free alkyl radical may follow the slow dissociation. The most plausible mechanism seems to be (1) followed by comparatively faster reactions as

$$\left.\begin{array}{l} C_2H_5 + O_2 \longrightarrow C_2H_5\cdot O\cdot O - - \\ \qquad\qquad \text{(very reactive radical)} \\ C_2H_5\cdot O\cdot O - - + C_2H_5I \longrightarrow \\ \qquad C_2H_5\cdot O\cdot O\cdot C_2H_5 + I \end{array}\right\} \text{(fast)}$$

Reaction (3) is also probable as dilution with water enhances the reaction velocity. However, if this mechanism were true, addition of an acid should shift the reaction to the left, *i.e.*, in the presence of H^+ ions, the observed reaction rate should decrease. On the contrary, it has been observed that addition of H^+ ions increases the velocity to a considerable extent. Therefore, this type of dissociation seems to be untenable. Applying the same arguments, (2) is also out of consideration.

Regarding possibility of (1), after the first stage of dissociation into a free radical, the function of the persulphate may be to oxidise the iodine radical to molecular iodine or the free alkyl radical itself may be oxidised to the peroxide,[2] by the oxygen from the persulphate, as indicated above. If free radicals are involved in the reaction, H^+ ions may accelerate the reaction unlike the other two suggested mechanisms.

When the reaction was carried out under similar conditions with nitric acid, another powerful oxidising agent, instead of potassium persulphate there was no iodine liberated. Therefore it would appear that this reaction is facilitated by the persulphate ions only. But the iodine from the alkyl iodide is also liberated by the action of H_2O_2. Therefore, it is some common property of $K_2S_2O_8$ and of H_2O_2 (other than that characteristic of the persulphate as an ion) which is responsible for the reaction. And that is the property of supplying oxygen to the free alkyl radicals into the very reactive R.O.O.-radicals which further may react with the undissociated alkyl iodine to form the peroxide, R.O.O.R. The usual method of the preparation of dialkyl peroxide is by the interaction of dialkyl sulphate and H_2O_2.[3] In a similar manner, alkyl iodides may form ultimately dialkyl peroxides by the action of H_2O_2 or $K_2S_2O_8$.

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March 28, 1940.

V. V. Nadkarny.

[1] Telang and Nadkarny, *J. Indian Chem. Soc.*, 1939, **16**, 536.

[2] Ziegler *et al.*, *Annalen.*, 1933, **504**, 131, 162.

[3] Baeyer and Villiger, *Ber.*, 1901, **24**, 738.

Yellow Mosaic of Bhendi

Yellow mosaic of 'bhendi' (*Hibiscus esculentus* L.) is widespread in occurrence and seriously affects the production of fruits.

The first visible symptom of bhendi yellow mosaic is the clearing of small veins and then of larger veins (Fig. 1). In young leaves these patterns are sharply delineated. The chlorotic areas are at first confined to the veins, but later they extend into the mesophyll and vary in colour from yellowish green to pale yellow. They are not clearly defined, but run out gradually into the normal background of the leaf. There is often a green patch of varying extent in the centre of each area. In badly

FIG. 1

Left.—A healthy bhendi plant.
Right.—A diseased bhendi plant showing clearing of the veins.

diseased plants, no marked mosaic but only a general chlorosis develops in the young leaves which may or may not show patches of light green. All growth subsequent to infection is dwarfed, the leaves remain small in size and the petioles are reduced in length. Infected plants blossom sparingly and produce few fruits. In nature plants remain susceptible to infection throughout their life. Under the glasshouse conditions, the diseased leaves show thickening of the veins on the lower side; but no foliar growth or enations are produced on the veins.

The virus of yellow mosaic is not sap-transmissible nor is the disease transmitted by the seed. The virus is easily transmitted by grafting.

Insects commonly found feeding on bhendi plants include *Empoasca devastans* Distant, *Empoasca* sp., *Aphis gossypii* Glover and *Bemisia gossypipera* M. and L. In feeding experiments, the first-named three species of insects failed to transmit the disease, but the white-fly, *Bemisia gossypiperda*, always transmitted the virus. The disease developed as a rule in from two to three weeks after the infective white-flies had fed on the healthy plants. The white-flies transmitted the virus of yellow mosaic to hollyhock plants, *Althaca rosea* Cav., and back to *Hibiscus esculentus*, but were unable to infect plants of 'Sakel' cotton.

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The Inheritance of a New Type of Purple Pigmentation Manifesting on the Glumes at Anthesis

THE sorghum plant develops purple pigment in many of its organs. Such pigmentation may develop at various times in its growth. One such organ is the glume. The glumes of the spikelets may or may not develop purple pigment. When they develop it, the commonest experience is for the glumes to emerge green and develop the purple pigment in the later stages of growth, from the dough to the ripe stages of the grain. An exception to this general condition has been noted when African varieties with the glumes emerging purple from the boot were met with. The simple dominance of this character has been reported.[1] In this note we are recording the occurrence and inheritance of a new type of purple pigmentation manifesting on the glumes. In this type, the spikelets emerge green from the boot. The purple pigment begins to develop on the glumes concurrent with the march of flowering. The pigment is of a light tint and anthocyanic. This character is best noticed in the full flush of flowering, when most of the glumes are tinted purple. When flowering is over, this faint purple fades away. This type of pigmentation is bound up with the flowering phase of the plant. When this has developed and faded away, the usual later dough grain stage manifestations of purple pigmentation could occur.

This rare type of manifestation occurs in the group *Sorghum conspicuum*, Snowden, from Tanganyika in Africa. One of the varieties from the Rufigi District in the Tanganyika territory, showed this character. In it, one natural cross occurred (A.S. 5939) without the manifestation of purple pigment during flowering. This was sown and the F_2 gave 134 plants without purple and 48 plants developing purple on the glumes at flowering time. From this an F_3 generation was raised. One selection which developed purple, bred pure. Of the three selections with no purple, one was pure for green glumes at flowering time and the two others segregated giving a total of 258 plants without purple and 88 plants with purple at flowering time.

It will thus be seen that a new gene, African in origin and confined to the group *S. conspicuum* has been met with. The effect of this gene is to develop a light purple pigment at flowering time, vanishing with the end of flowering. This character has proved a simple recessive to the common unpigmented condition. Whereas many dominant genes producing purple pigment in various parts of the sorghum plant and at various times in its life-cycle have been traced to Africa, this African recessive purple pigment gene is of added interest.

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[1] *Curr. Sci.*, 1937, **5**, 590.

The Occurrence and Inheritance of Purple Hairs on the Spikelets of Sorghum

The generality of sorghums are hairy in some part or other of their spikelets. This hairiness shows best on the glumes. The pedicels of the pedicelled spikelets and the callus are generally hairy. The glumes may be glabrous, and when hairy, may vary in the intensity of the hairiness. When most intense, they are felty. When sparse, the hairiness is confined to the top third of the glume, and when sparser still, to a fringe of hairs at the edges. These hairs are usually hyaline. In stray cases these are purple pigmented and show best at flowering time after which the pigment fades away. Purple haired spikelets occur mostly in African varieties. Some Indian varieties and the wild sorghums have also some types with purple-haired spikelets. When the spikelets are hairy, it is usual for the nodal band (the soft tissue at the very base of the leaf-sheath) and the auricular junction (the light-coloured tissue connecting the base of the leaf-blade with the top of the leaf-sheath) to be hairy also; but when the spikelet hairs are purple pigmented, such pigment does not affect the hairs on the nodal band and the auricular junction.

A.S. 4212 is a selection from a North Rhodesian variety and its spikelets have purple hairs. A selection from this, *viz.*, A.S. 5896, which was obviously a natural cross, segregated for this character giving 87 plants with purple-haired spikelets and 31 with hyaline ones. Three purple and one hyaline selections were taken from this family and an F_3 raised. The hyaline-haired selection bred true. All the three purple-haired selections segregated giving a total of 282 plants with purple and 91 with hyaline hairs on the spikelets.

It is thus seen that purple pigmented hairs on the spikelets of sorghum are a monogenic dominant to the usual hyaline condition.

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A Modified Form of Acetocarmine

Belling's Acetocarmine[1] has been of considerable use to cytologists, in the study of nuclear divisions and any extension of its use would be welcome. As Ganeshan[2] has pointed out, there are two sources of trouble in its use. First, acetocarmine deteriorates very rapidly

under tropical conditions, though protected from bright light. Secondly, even when freshly prepared, it does not stain adequately some plant smears. To overcome these disadvantages, the addition of adjuvants to the stain was tried.

One such adjuvant, 'Igepon T', manufactured by the I. G. Farben-Industrie of Germany, was found to be useful, added in this manner. About 0·2 gm. of 'Igepon T.' is dissolved in 45 per cent. aqueous solution of acetic acid and powdered carmine is added while it is boiling. Addition of iron salt to the solution is inadvisable, but if desired the salt might be added after the smear is mounted in this carmine.

The chromosomes take some time to stain, full colour being attained after 10 minutes. Provided the adhesion between cells and slide is good, the smear can be rinsed with rectified spirit, dehydrated with absolute alcohol, cleared and mounted in canada balsam. The cytoplasm can be counterstained with Light Green, if desired. In making the permanent mount, the cytoplasm shrinks appreciably, but not the nucleus.

The addition of 'Igepon T.' checks rapid deterioration of the acetocarmine. (The photograph, Fig. 1, is of pollen mother cells of

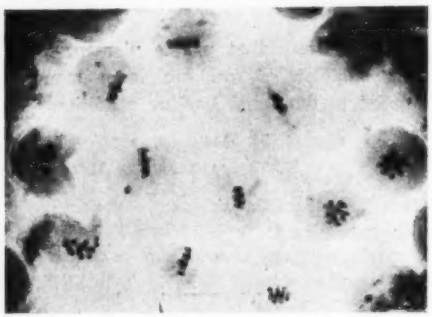

FIG. 1

P.M.C. of Tropeolum in first division metaphase

Tropeolum majus, in the first division metaphase stage, prepared in the above manner with a month old acetocarmine). It appears as if the carmine does not form a true solution in the acetic acid and that the addition of 'Igepon T.' checks the precipitation of the carmine. The adjuvant, however, improves only slightly the staining qualities of the acetocarmine. But if pure carminic acid is used instead of powdered carmine, in the preparation of the solution, the staining qualities are also improved. But the acid is much more expensive than carmine and the colour of the chromosomes, when stained, is a dull brown.

'Igepon T.' is an emulsifier, a synthetic wetting agent of value in dyeing textiles. It is apparently a sulphonated long chain unsaturated fatty acid. Similar products are marketed by a few other dye manufacturers (American and French) under different trade names and are likely to prove just as useful.

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April 17, 1940.

[1] Belling, J., *Biol. Bull.*, 1926, **50**, 160.
[2] Ganeshan, D., *Curr. Sci.*, 1939, **8**, 114.

A Preliminary Note on the Fission of Vascular Cylinder in Some of the Roots of *Hydrocotyle asiatica*, Linn.

SOME of the old root-bases of *Hydrocotyle asiatica* Linn. show fission of the vascular cylinder and the separated masses of bundles become arranged in a circle as shown in Fig. 1. Serial transverse sections from the tip up to the base of the root with the said cleavage of the vascular cylinder reveal the normal secondary thickening of the dicotyledonous type near the root apex. When traced gradually towards the base, the continuous circular cambium ring becomes constricted into a triangular, quadrangular or pentangular arc, ultimately each arc embracing each of the xylen bundles of the stele.

Similarly, the larger mass of the xylem breaks up into as many smaller bundles as there are primary xylem bundles included in it. Almost simultaneously with the formation of these smaller bundles, they are forced away

from the centre and from one another by the vigorously growing parenchymatous cells which arise from the smaller rings of cambium. Each of these separate bundles, thus formed by the cleavage of the vascular cylinder, looks more or less circular with sufficient secondary growth of wood elements amongst the primary xylem bundle. Rays of parenchyma gradually widening towards the cortex are found in continuation of the primary xylem bundles and groups of parenchymatous cells are seen scattered in the secondary wood elements. The smaller ring of cambium round each of these cleft xylem-masses is circular at first, but in sufficiently advanced stage of secondary growth the cells of the cambium can scarcely be marked out from the remaining portions of the separate bundle. The primary phlœm bundles are found situated at the outer end of the central broad medullary rays just alternating the primary xylem bundles placed towards the centre of the section. Starch grains are deposited abundantly in the parenchymatous ray cells. Phellogen appears in the pericycle inside the endodermis, which extends at first sufficiently only to break up ultimately into numerous segments, their cells having flattened tangentially in the mean time. In the primary tissues of the root the resin canals are found opposite the xylem and the phlœm groups of the primary vascular strands as remarked by Solereder.[1] After secondary growth the resin canals are also seen inside the phelloderm as shown in Figs. 1 and 2. In old root-bases after sufficient secondary growth has advanced, cortex disappears completely from the older part (Fig. 1), though its presence is evident in the younger one (Fig. 2).

Almost similar fission of the xylem was shown by Koch[2] in the mature napiform roots of *Sedum maximum* Sut. of the family Crassulaceæ and its allies. It occurs only in the middle (not in the upper or lower) portion of the roots as summarised by Solereder.[1] In transverse section this region shows a circle of concentric vascular bundles with central wood. Originally the fibro-vascular system of the roots had normal structure. Subsequently, however, the ring of cambium breaks up into a number of separate arcs, which extend round the portions of the original xylem and enclose them in an annular manner. In the family Umbelliferæ according to Ternetz[3] *Azorella selago* Hook. f. exhibits fission of the xylem mass in the older parts of the stem, and in the roots. In the young axis of this plant the vascular bundles are loosely arranged in the normal way to form a ring. In the course of growth in thickness and the simultaneous development of cork, a process of disorganization starts in the parenchymatous ground-tissues and in the outer portion of the secondary cortex, both of which become partly transformed into a kind of complementary tissue; at the same time clefts are formed, which have

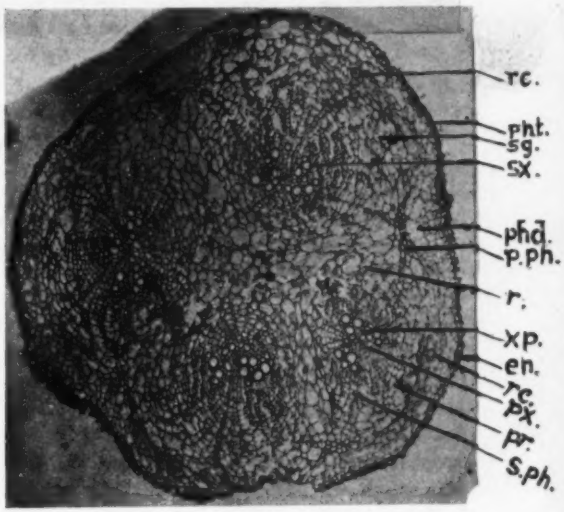

FIG. 1

Transverse section of an old root of *Hydrocotyle asiatica* L. from near the root-base

en.–endodermal cells disorganised at some places; *phl.*–phellogen; *phd.*–phelloderm; *px.*–primary xylem bundles; *p.ph.*–primary phlœm bundles; *sx.*–secondary xylem; *s.ph.*–secondary phlœm; *pr.*–parenchymatous ray cells gradually widening towards the cortex; *xp.*–groups of xylem parenchyma; *r.*–ray cells separating the vascular bundles from one another; *sg.*–starch grains in the parenchymatous cells; *rc.*–resin canals inside the phelloderm; (Photomicrograph. Eye-piece 5 × and objective 16 mm.)

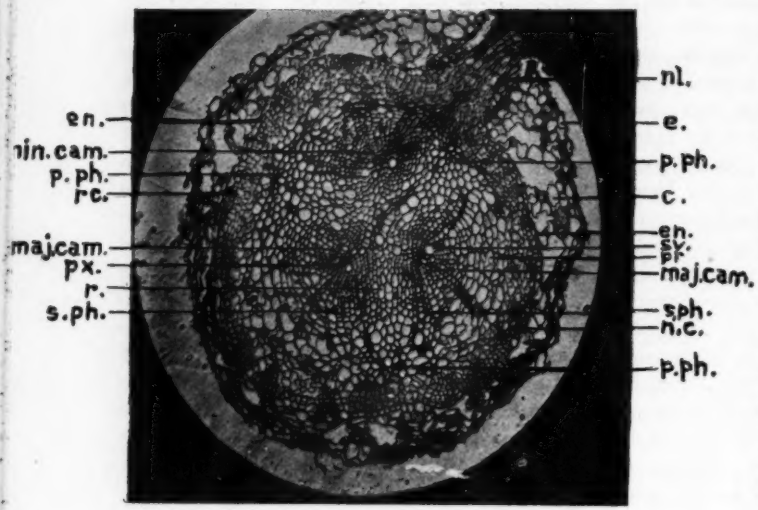

FIG. 2

Transverse section of another root of *Hydrocotyle asiatica* L. with triarch vascular bundles and cambium broken up into 2 arcs

e.–epidermis; *c.*–loosely arranged cortical cells; *en.*–endodermis; *px.*–primary xylem bundles; *p.ph.*–primary phloem bundles; *pr.*–parenchymatous ray cells gradually widening towards the cortex; *sv.*–secondary xylem vessels—youngest ones not yet lignified; *s.ph.*–secondary phloem; *r.*–ray cells separating the vascular bundles from one another; *maj. cam.*–major arc of cambium enclosing two xylem bundles; *min. cam.*–minor arc of cambium enclosing one xylem bundle.; *rl.*–production of a rootlet; *rc.*–resin canals (Photomicrograph. Eye-piece 7·5 × and objective 16 mm.)

an approximately radial course and also penetrate between the groups of wood in the direction of the pith. When the axis has attained a thickness of 5–6 mm., meristematic tissue commences to develop in the region of the xylem-mass, *viz.*, along the radial clefts and on the inner side of xylem-segments; this meristematic tissue gives rise to a parenchyma, which undergoes dilatation. The appearance of secondary meristems forming wood and bast in this parenchyma and their junction with the normal cambium of the vascular bundles then leads to the development of a kind of polystely; in consequence of further cleavage, however, this structure soon becomes disturbed, and gives way to a maze of separate segments of wood and bast irregularly interwoven with one another. The anomalous root-structure of *Oenanthe*, *Magydaris* and *Myrrhis*, etc., of the same family (Umbelliferæ) is of a quite different nature. In summarising cleavage of the xylem-mass in stems in general and also sometimes in roots, Solereder[1] remarks that the ring of wood commences to split up into a number of separate strands by a process of dilatation, i.e., cell division in the parenchyma of the woods, in the pith and the medullary rays. Subsequently, meristems, which produce wood and bast are frequently developed in connection with these strands. According to Solereder[1] a cleft xylem-mass is found in some plants of (1) Caryophyllaceæ, (2) Malpighiaceæ, (2) Sapindaceæ, (4) Cæsalpinieæ (Bauhinia, stem and root), (5) Umbelliferæ, (6) Asclepiadeæ, (7) Convolvulaceæ, (8) Bignoniaceæ, (9) Acanthaceæ, and (10) Aristolochiaceæ.

Dastur and Kapadia[4] have noted the fission of xylem caused by the dilatation-parenchyma in the aerial and the underground roots of *Tinospora cordifolia* Miers. (Fam. Menispermaceæ). Recently, P. C. Joshi[5] has found the stele of old stems and roots of *Thylacospermum rupifragum* Schrenk, a Tibetan Caryophyllaceous plant, splits up into numerous irregular vascular strands in a manner similar to that found in some tropical lianes and in some fleshy roots described by De Bary,[6] Haberlandt[7] and others. He also cites somewhat similar anomaly in the root of another Tibetan plant, *Stellera chamæjasme* Linn. of the family Thymelæaceæ worked out by A. C. Joshi.[8] P. C. Joshi,[5] however, could not find deposit of food substances in any part of the stem and root; but, as I have mentioned before, abundant starch grains are

present in medullary rays and secondary cortex of my specimen (Fig. 1).

In conclusion, I wish to express my gratitude to Dr. S. R. Bose, Professor of Botany of this College, for his valuable help and favourable criticism.

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March 20, 1940.

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[1] Solereder, H., *Systematic Anatomy of the Dicotyledons* (Eng. Trans.), Oxford, 1908.

[2] Koch, L., *Entwickl. d. Crass., Verh. naturhist. med. ver. Zer. zu Heidelberg*, 1874, 4 Heft.

[3] Ternetz, Ch., *Bot. Zeit.*, 1902, 60 : 1–20 and Tab. 1.

[4] Dastur, R. H., and Kapadia, G. A., *J. Ind. Bot. Soc.*, 1931, **10**, 110.

[5] Joshi, P. C., *Proc. Ind. Acad. Sci.*, 1936, **4**, 52.

[6] De Bary, A., *Comparative Anatomy of the Phanerogams and Ferns* (Eng. Trans.), Oxford, 1884.

[7] Haberlandt, G., *Physiological Plant Anatomy* (Eng. Trans.), London 1914.

[8] Joshi, A. C., *Proc. Ind. Acad. Sci.*, 1935, **2**, 424.

Vernalisation of Indian Crops

EXTENSIVE investigations were carried out for the last two years to vernalise (accelerate the flowering date) through the Russian method of pre-sowing cold treatment of the seeds of some of the economic crops, *viz.*, wheat, barley, oat, gram, pea and cicer. The seeds were soaked in water for four to five hours and after rinsing out the superfluous water, the swollen seeds were placed inside a refrigerator set at a temperature ranging from 6° C. to 8° C. and kept for different periods, 7, 14 and 21 days. In the latter period the coleoptiles protruded from 3 mm. to 5 mm. in length. In none of the experimental crops under the different periods of treatment any significant shortening of the flowering time could be observed. The experiments were repeated in more than one season. The non-response of the tropical crops to this method of pre-treatment as compared to the favourable response of the temperate crops to the latter may be attributed to (1) the qualitative difference between the phasic development of the temperate crops with their lower temperature (thermal stage) and long day conditions (photostage), and the tropical crops with their warmer thermostage and photostage of short day conditions; (2) the effect if any, of the pre-sowing thermal treatment and its possible dependence on the subsequent periods of photostage according to the long or short day conditions, in which the plant has to grow; (3) the probability that the combination of pre-sowing cold treatment and long day conditions as is the case in the temperate climates is only effective, while short day conditions may tend to retard it. This fact seems more evident when actually the cold treatment fails to bring any significant response in the tropical crops.

Therefore the problem of vernalisation of Indian crops presents itself for further investigations under the following aspects: (1) Effect of pre-sowing treatment alone; (2) supplementing the pre-sowing treatment with further post-sowing photostages; (3) is it possible to give the post-sowing photostages as a pre-sowing treatment? Accordingly a scheme as shown in Table I was worked out in case of wheat Pusa var. 165.

From the above set of experiments some very interesting results were obtained. In Experiments 1 and 2 no earliness in the ear emergence was observed either in cold or in warm pre-sowing treatments; but a marked earliness sets in as a result of supplemented post-photoperiodic treatments, being 6·0 days for 24 hours and 12 hours periods and no earliness for 6 hours period. In all the post-sowing photoperiodic treatments in Experiments 1 and 2 the control set behaves similarly as the treated ones, *i.e.*, the same degree of earliness is seen as a result of the post-sowing photoperiodic treatment irrespective of whether the seeds were vernalised or not vernalised at all. In Experiments 3, 4 and 5 thermal factor as supplemented by photo factor as a pre-sowing treatment brings in an earliness of 3·0 days from that of the control; but by a further dose of post-sowing photoperiodic treatment a marked earliness of 15·0 days sets in, in 24 hours

TABLE I

No. of Expts.	Pre-sowing treatments			Post-sowing treatments*				
	Thermal factor	Photo-factor	Duration of treatment	Control	Photo-periods			Duration of treatment
					1 set	2 set	3 set	
			days		hrs.	hrs.	hrs.	days
1	Cold 6°–8° C. ..	Darkness	9	Normal day and night temperature and photo-periods	6	12	24	10
2	Warm 20°–22° C. ..	do.	9	do.	do.	do.	do.	do.
3	Cold 6°–8° C. (9 days) ..	24 hrs. from a 200 watt lamp at a distance of 1 ft. (9 days)	9 + 9	do.	do.	do.	do.	do.
4	Warm 20°–22° C. ..	do.	9 + 9	do.	6	12	24	10
5	..	do.	9	do.	do.	do.	do.	do.
6	*Control.*—Seeds soaked for 4 to 5 hours and sown simultaneously with the treated ones →			Given the same photo-periods				

* Seeds were treated to different photo-periods for the duration of the first ten days from the date of sprouting and then allowed to grow under normal day and night conditions.

light period and 7·0 days in 12 hours light period. This is very significant and indicates the tendency of the earliness to appear when the applied dose of photo factor is greater.

The important results may be summarised in Table II.

The results tabulated under 1, 2, 3 and 4, show the influence of the photo factor in pre- and post-sowing stages in inducing earliness of flowering. From (1) and (3) we find that a pre-sowing photo-treatment hastens the earliness of flowering by three days only, while from (2) and (4) we find that a similar pre-sowing treatment on plants which are further subjected to post-sowing photo-treatment increases the earliness of flowering from 6 to 15 days.

From the above it seems that in tropical wheat the second phase of photostage brings in a complication which tends to retard the process of vernalisation by pre-sowing cold treatment which is found to be successful with the temperate wheat. Investigations to further

TABLE II

No.	Treatments	Mean ear emergence from the date of sowing		Earliness in days
		Treated	Control	
		days	days	
1	Vernalised in cold or warm and allowed to grow under normal day and night conditions ..	54	54	Nil
2	Vernalised in warm or cold and allowed to grow under the photo-periods of			
	6 hours ..	54	54	Nil
	12 ,, ..	48	54	6·0
	24 ,, ..	48	54	6·0
3	Vernalised in light and allowed to grow under normal day and night conditions ..	52	55	3·0
4	Vernalised in light and allowed to grow under the photo-periods of			
	12 hours ..	48	55	7·0
	24 ,, ..	40	55	15·0

elucidate the above facts and to find out the nature of the phasic development of the tropical plants are in progress in this Institute and some of the valuable results so far obtained are in course of publication.

B. K. KAR.

Bose Research Institute,
Calcutta,
March 12, 1940.

Volant Animals which act as Carriers of San Jose' Scale

THE San Jose' Scale [*Quadraspidiotus* (*Aspidiotus*) *perniciosus* Comst.] is a destructive pest of deciduous fruit trees. It is commonly distributed through nursery stock. Once it is established in a locality it gets distributed, among other means, by those flying animals which visit an infested fruit tree either to feed, or for shelter and rest as well. World literature dealing with the spread of this pest was consulted and it was found that the information concerning the species of volant animals which act as carriers of its nymphs was extremely meagre. Therefore, it was decided to find out the species of these volants in N.W. India and the work was carried out in the autumn of 1939 in the Kulu Valley.

For the purpose of this study birds and bats were shot from the infested and uninfested orchards as well as from the infested and uninfested plants in the jungle and solitary plants in the fields. During the period that this work was in progress 266 birds and bats were killed and this number comprised 26 species of birds and one species of bats. As soon as the shot animal dropped to the ground it was picked up, placed on a white paper and its legs examined for nymphs very carefully with a hand lens. It was then fumigated and shaken, and the nymphs that dropped off its body were collected for their identification in the laboratory.

The nymphs of San Jose' Scale were found on the following six (1–6) species of Passerine birds and on a (7) bat:

1. The Yellow-billed Magpie: "Chhanchhla" or "Tying-jogring" (*Urocissa flavirostris flavirostris* Blyth.: Corvidæ).
2. The Indian Jungle Crow: "Dhal Kawa" or "Jangli kawa" (*Corvus macrorhynchus levaillanti* Less.: Corvidæ).
3. The Common Indian House Crow: "Kawa" (*Corvus splendens splendens* Vieill.: Corvidæ).
4. The Common Myna: "Desi-maina" (*Acridotheres tristis tristis* Linn.: Sturnidæ).
5. The Simla Streaked Laughing-Thrush: (*Trochalopterum lineatum griseicentior* Hartert: Timaliidæ).
6. The White-cheeked Bulbul: "Painju" (*Molpastes leucogenys* Gray: *Pycnonotidæ*).
7. The Flying Fox: "Barbagal" or "Badur" (*Pteropus giganteus giganteus* Brun.: Pteropodidæ).

Out of these, the first four species (1–4) of birds and the bat (7) are very commonly met with in the valley while the last two species of birds (5–6) are comparatively rare.

We are grateful to the Punjab Government for their very kindly granting exemption from all provisions of Section 7 of the Punjab Wild Birds and Wild Animals Protection Act (in the Kulu Valley) and to the Curator, Bombay Natural History Society, for his confirming our identification of Nos. 1–4 and for identifying Nos. 5–7.

KHAN A. RAHMAN.
ASA NAND KALRA.

Entomological Laboratory,
Punjab Agricultural College,
Lyallpur,
April 30, 1940.

Detection of Adulteration in "Ghee" (*Clarified Butter*) by the Fluorescence Technique

IN the March issue of *Current Science*, a note[1] was published suggesting a new method for the detection of adulteration in ghee. The authors of this note do not seem to be aware of the work of J. B. Jha,[2] which they have confirmed and which appeared some seven months back in one of the well-known scientific journals of this country.

The two studies, referred to above, were confined to fresh samples. It is well known that ghee when left to age under commercial conditions undergoes putrefactive changes and the resulting product is very different. It would be of interest to study the behaviour of the old ghees in the ultra-violet light.

While it cannot pretend to replace the accepted quantitative chemical methods, now in use, the method deserves careful trial as it appears to be both simple and informative. It is, however, difficult to see how such a costly equipment can find favour with the analysts.

G. NARASIMHAMURTY.

Municipal Laboratories,
C. & M. Station, Bangalore,
May 1, 1940.

[1] Muthanna, M. C., and Mukerji, B., *Curr. Sci.*, 1940, 9, 120.

[2] Jha, J. B., *J. Ind. Chem. Soc., Ind. and News Edn.*, 1939, 2, 159.

WE take this opportunity of thanking Mr. Narasimhamurty for drawing our attention to the article of Mr. J. B. Jha. It is a pity that this contribution was missed by us in spite of the fact that one of us (B.M.) is a member of the Board of Editorial Correspondence of the *Journal of the Indian Chemical Society*. However, a subsequent perusal of Mr. Jha's article appears to indicate that he covered only a part of the ground which we had hoped to study. Mr. Jha undoubtedly had the idea of testing the purity of 'ghee' by ultra-violet fluorescence analysis, but he made no attempt to give his method the 'quantitative touch' necessary to measure accurately the amount of adulterant present in a particular sample. We found that by the fluorescence technique (employing the naked eye), it was extremely difficult, nay almost impossible, to detect 20 per cent. or less of adulteration in 'ghee'. Hence we found it necessary to employ a device (Pulfrich photometer and filtered ultra-violet light) by which the intensity of fluorescence emitted could be actually measured in terms of some numerical unit and standard curves drawn for the more common adulterants. An accurate estimate of the percentage of an adulterant present can only be determined by a reference to these standard curves.

Mr. Narasimhamurty has brought out an interesting point with regard to the ageing of 'ghee' and the response of such 'ghee' to ultra-violet fluorescence. This is an important question and is already receiving our attention, though our work in this direction has not yet progressed to a stage to make a pronouncement on the subject possible.

We fully realise that this method of fluorescence analysis is not perfected to such an extent as to replace the existing methods universally employed for 'ghee' analysis, but we feel that it holds out possibilities and deserves further and more extensive trials by the analysts. With regard to the question of cost, Mr. Narasimhamurty has not apparently taken into account the fact that the outlay for a Pulfrich photometer assembly, although fairly expensive, is only an initial outlay and does not involve a recurring expenditure of any magnitude. Further such an equipment will come to the service of analysts in more than one sphere, *e.g.*, detection of adulteration in vinegar, spices, eggs, drugs, etc. It is yet too premature to foresee the utility of such an assembly in an analytical laboratory.

M. C. MUTHANNA.
B. MUKERJI.

Biochemical Standardisation Laboratory,
Calcutta,
May 13, 1940.

REVIEWS

The Mathematical Theory of Huygens' Principle. By B. B. Baker and E. T. Copson. (Clarendon Press, Oxford), 1939. Pp. 135. Price 12*sh.* 6*d.*

The book is a monograph which deals with the Mathematical Theory of Huygens' Principle and discusses the general theory of the solution of the partial differential equations which govern the propagation of light. Some simple diffraction problems which serve as illustrations have also been discussed.

The book is divided into four chapters. In the first chapter, the scalar form of Huygens' principle, as applied to the propagation of sound waves has been considered. The validity of the application of Huygens' principle in Optics has also been discussed. In this connection it may be mentioned that a light wave is specified by the three components of the "Light Vector" whereas a sound wave is characterised by a single quantity. Wave motions in two and three dimensions have been considered. Hadamard's "Method of descent", i.e., the mode of finding two-dimensional cylindrical wave-functions by applying the method of determining three-dimensional wave-functions under certain conditions has also been explained. The solutions of the equation of cylindrical waves as given by Weber, Volterra and Marcel Riesz have also been discussed.

In the theories of Volterra and Hadamard, there are certain awkward limiting processes which Riesz avoided in his elegant method by introducing an arbitrary complex parameter α and by applying the theory of analytical continuation of a function of a complex variable. There is a great disadvantage in Hadamard's method. He did not avoid the occurrence of divergent integrals but devised a method of picking out "finite parts" of such integrals. But the method of picking out the finite part of a divergent integral can only be applied to a space having an even number of dimensions. In the space of an odd number of dimensions Hadamard's method does not apply. It is an established fact that diffusion of wave-motion always occurs in space of an even number of dimensions whereas in a space of odd number of dimensions it may or may not occur. The solution obtained by Riesz's method is independent of the number of spatial dimensions and so it has got a great advantage over other methods.

In the second chapter, Kirchoff's and Kottler's theories of diffraction by a black screen have been discussed. Kirchoff obtained his formula for diffraction on the assumption of certain boundary conditions which have been found to be incompatible with each other. In spite of this difficulty the above formula gives results which agree remarkably well with experiments. Many authors regard this formula as a fairly accurate first approximation; on the other hand Kottler and other authors think that Kirchoff's formula is an accurate solution of a "*saltus problem*", and it is not to be taken as a boundary value problem. By giving a different definition of blackness, Kottler deduces the formula quite rigorously. As a satisfactory physical definition of a thin black screen is not possible, Kottler gives an analytical definition of blackness for such a screen.

In the third chapter, analytical formulation of Huygens' principle for electromagnetic waves has been developed. It is shewn that the formula of Kirchoff and of Larmor and Tedone for diffraction are equivalent so far as both "express the components of electric and magnetic vectors as integrals over a closed surface; the two formulæ differ by a quantity which vanishes in virtue of Green's theorem". But these formulæ are inadequate as neither of them when applied to the components of an electro-magnetic field having an open surface of integration leads to the solution of Maxwell's equations.

It may be mentioned that Kottler's definition of "black screen" is quite satisfactory as no energy is reflected from such a screen.

In the fourth chapter, Sommerfeld's theory of diffraction has been fully discussed. Sommerfeld has successfully used many valued solutions of Maxwell's equations to problems of diffraction of light caused by a perfectly reflecting half plane or wedge. Sommerfeld has introduced the idea of "Reimann Space" into diffraction problems. The treatment is analogous to similar two-dimensional problems in electrostatics. When many valued solutions of

Maxwell's equations in ordinary three-dimensional space get transformed in a "Riemann Space", they become single-valued functions of position in the latter (Riemann) Space. This "Riemann Space" is quite different from "Riemannian Space" considered in modern differential geometry.

An ideal black screen cannot be attained experimentally, nor precisely defined in electromagnetic theory. Ignatowsky has rightly observed that as it is not possible to have any general definition of black screen which is applicable to every case, each diffraction problem relating to such a screen must be discussed separately on its own merit. The theory of diffraction by a perfectly reflecting screen as worked out by Sommerfeld may be accepted as quite a satisfactory one.

The printing and get-up of the book are excellent and it may serve as quite a good text-book for those who want to make a specialised study of Huygens' principle. The number of diffraction problems that have been discussed is rather restricted. The usefulness of the book would have been greater and it would have served better as a standard book of reference if a more complete account of different methods of solving special diffraction problems were given. A judicious choice of additional problems illustrative of technical developments of the theory of diffraction would make the monograph complete in itself without unduly increasing its size.

A. C. BANERJI.

Advanced Algebra. By S. Bernard and J. M. Child. (Macmillan & Co., London), 1939. Pp. x + 280. Price 16*sh.*

This book is the promised continuation of the same authors' *Higher Algebra* which appeared sometime ago. It contains chapters on quadratic residues, primitive roots, sums of two or more squares, indeterminate equations of the second degree, continued fractions and invariants. Several chapters are devoted to topics not strictly algebraic —double series, uniform convergence, complex variables, life contingencies, etc. A large number of examples are provided and a collection of miscellaneous examples is placed at the end of the book.

It must be confessed that on the whole the book is a little disappointing. One misses the true algebraic spirit in a book which professes to be an introduction to *Advanced Algebra*. We look, in vain, for even a mention of the important concepts of ring, group, field, ideal, etc.,—concepts which have raised Algebra to a ruling position in modern mathematics. Considering the very important part played by modern algebra both in pure mathematics and in mathematical physics, one would naturally have expected to find an elementary exposition of abstract algebra—an exposition, say, which would serve as an introduction to the beautiful texts by van der Waerden and Albert. The desirability of introducing the student early to the concepts and methods of abstract algebra has been affirmed repeatedly,* and Weyl's dictum† that "a knowledge of them should be as widely disseminated as the elements of the differential calculus" applies to-day with even greater force. Quite a good deal of space is devoted to a discussion of double series, uniform convergence and other topics of analysis; surely this is unnecessary in a text-book on Advanced Algebra at the present time, when nearly every week brings forth new Text-books of Convergence and Introductions to Analysis!

These remarks must be understood to refer to the general plan of the book and the total impression created by it, and not to the treatment of the individual topics in the various chapters. Perhaps the book might meet the needs of students who have in view the exigencies of certain examinations and whose main interests are otherwise than algebraic. But it is of little help to those who are interested in modern Algebra either for its own sake or on account of its manifold applications.

V. R. THIRUVENKATACHAR.

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* For a recent statement, see *Amer. Math. Monthly*, 1939, **46**, 635–42 and *Math. Gaz.*, 1940, **24**, 15.

† Weyl, *The Theory of Groups and Quantum Mechanics*, p. xxii.

Astronomy. By William T. Skilling and Robert S. Richardson. (Chapman & Hall, Ltd., London), 1939. Pp. 579. Price 15*sh.*

The aim of the authors in preparing this attractive book seems to be to provide a suitable text-book that can be used by students taking a first (or elementary) course in astronomy in college classes. It deals mostly with the descriptive parts of the science without entering into the technical or mathematical details. A glance through the pages will be sufficient to show that the book possesses certain distinctive

characteristics not found in the general range of text-books available in the subject. The order and style of presentation appear to be excellent and the language is as far as possible, simple and non-technical, so that the book may meet the requirements of the intelligent layman as well, who desires to have a concise account of the main facts of descriptive astronomy. Considerable care has been exercised in the choice of material and emphasis has been laid on those topics which according to the authors "should become common knowledge to all educated people".

The earth, as the abode of the observer, is treated in the first chapter, and in the second, there is a clear explanation of the various systems of co-ordinates employed by astronomers for locating heavenly bodies on the celestial sphere. It is noteworthy that the idea of galactic co-ordinates, which plays such an important part in studies of stellar dynamics, is introduced so early in the course. Chapter III contains a description of the general equipment of a modern observatory and the uses of the several instruments. There are sections dealing briefly with astronomical photography and spectroscopy; mention may be made of the concise description of the Schmidt Camera and the blink comparator, the use of which has come into prominence during recent years. The next two chapters are devoted to the study of the sun—the star nearest to the earth—which is treated in all its details. Chapters VI to VIII deal respectively with Time and the Calendar, the Moon, and Eclipses, where at the end, is included an account of an interesting eclipse expedition. We have next an excellent chapter on the "Tides, their nature and causes". The solar system as a whole is treated in Chapter X which is followed by chapters on Planets described individually, Comets and Meteors.

The main facts of sidereal astronomy are presented in the two succeeding chapters where we find a succinct account of the methods of determination of stellar parallaxes, the motions of stars and their arrangement in space as well as the phenomenon of galactic rotation, recently discovered by Plaskett and Oort. Chapter XVI entitled "Differences among stars" deals with a variety of topics such as brightness of stars, apparent and absolute magnitudes, the size of stars, stellar spectra, giant and dwarf stars, and the general problem of variable stars. The treatment is fairly elementary, and the principal results have been clearly summarized. Nebulæ—galactic and extra galactic—form the subject-matter of the last chapter which gives a complete survey of our present knowledge of these interesting objects and their place in the Universe. The glossary at the end of the book will be found specially useful, by the beginner in mastering the technical terms.

The problems and exercises given at the end of each chapter will be of great help to the student preparing for university examinations. The illustrations are good and have been carefully selected; and the get-up, on the whole, is excellent. The book may be confidently recommended to the student taking a first course in the subject, as well as to the general reader who requires a concise and up-to-date account of the various topics of descriptive astronomy.

T. P. B.

College Course of Inorganic Chemistry. By Partington. (Macmillan & Company, London), 1939. Pp. x + 658. Price 8*sh.* 6*d.*

This is a very good text-book of Inorganic Chemistry for students of the Intermediate Science courses of the Indian Universities, although it goes even beyond their requirements. As the author himself admits, this is in many respects an abridgment of the author's larger text-book of Inorganic Chemistry for University students, meeting just the needs of the beginners. The book commences with the general principles of Chemistry and then deals with the chemistry of the common elements like oxygen, hydrogen and the halogens. Then a few chapters on Physical Chemistry are written giving elementary ideas on electrolytic dissociation, molecular weights, chemical equilibrium and law of mass action. The subsequent chapter deals with the periodic law and atomic structure wherein elementary ideas on the modern concepts of valency have also been clearly given. Thereafter the chemistry of important elements is described in the order of the groups in the periodic table. The historical approach which really introduces an element of interest and reality has often been used. This book will thus be of very great use for the Intermediate students.

M. SESHAIYENGAR.

Laboratory Methods of Biochemistry. By A. Bertho and W. Grassmann, translated by W. McCartney. (Macmillan & Co., Ltd., London), 1938. Pp. xiv + 281. Price 8*sh*.

In a rapidly expanding field of science like modern biochemistry, it is difficult to bring out a volume on practical biochemistry, which will remain unsuperseded in a short interval of time. Improvements in the technique of preparation and measurement are being continuously introduced in this field.

The present volume serves as a useful and intensely practical volume for the young biochemist who is to be initiated into the subject. This is a companion volume to Gattermann and Wieland's Laboratory methods in organic chemistry. Biochemistry is not taught in many of the Indian universities and in a few others, adequate attention is not paid to this subject. We have no doubt that this defect will soon be remedied. The appearance of this handy volume will be welcomed by all the universities who wish to encourage the study of biochemistry.

M. S.

Modern Inorganic Chemistry in Tamil —Part I. By N. Anantavaidhyanathan. (Annamalai University, Annamalainagar), 1938. Pp. xxx + 1264. Price Rs. 3.

This book on Chemistry is a pioneer attempt in Tamil. Many of its 36 chapters make very interesting reading. The chapter on periodic classification is particularly well written. Advanced matter, not intended for the students of the Intermediate classes, is printed in small type. There are 171 clear-cut diagrams and 13 photogravures. The format is good. This excellent but bulky book is priced at only Three Rupees. It is hoped that the second part of this book will contain the necessary index, without which even good books become difficult to use. The talented author and the Annamalai University are to be heartily congratulated for producing and publishing a book of this kind and the reputation of the University will be enhanced if it can make arrangements to use its own publications in its University Classes.

An intolerable situation has arisen in Tamil with regard to Chemical nomenclature and terminology. Departmental Committees, set up ten years ago to find out or coin Tamil equivalents of Scientific terms, took the index of standard science books and, coined, according to their intuition, intelligence and experience, a set of Tamil equivalents, often derived from Sanskrit roots and occasionally selected from Tamil usage, and they were duly published by the Government. Authors, who wrote text-books in Tamil for use in the High School classes, used these Tamil equivalents, good, bad or indifferent, in their books since they thought that by a religious adherence to 'approved' terms, their books would be readily and easily recognised by the Text-book Committees. And Sri. Anantavaidhyanathan has also adopted a similar procedure in his book. The result is an unpleasant jargon rich with hard, disagreeable and fantastic words and phrases in a Tamil garb. The method followed by the authors of the Text-Book in Chemistry in Urdu published by the Osmania University, Hyderabad, is different. They have rightly transliterated the English terms without endeavouring to coin Urdu equivalents for the chemical terms used in their book. The reviewer feels strongly that the latter system would have been appropriate, less cumbersome, and more elegant and easier to follow in Tamil also. Any living language must enrich itself with words from trade and commerce, science and invention and war, and the Tamil language, if it should grow, must do so now and in the future as it did in the past. It is a relief to find that the author has not coined Tamil words for petrol, benzene, gram, litre, litmus and other words. He would have done well to have adhered to his dictum elaborated on page xiii of his book.

Within the limits of our space only a few instances of the errors of omission and commission found scattered in the pages of the book may be noticed. The author has used the English symbols for the Tamil names of elements, and equations are also given in English to represent chemical reactions! A uniform method must be followed. In a standard text-book on Inorganic chemistry such interjections, expletives and philosophisings as are found on pages 52, 834, 1207 and other pages may well be omitted. The size of the book could well be reduced by omitting the many biographical and historical details and also the extracts from Sanskrit and Tamil literature like those found on pages 44, 47, 308 and 738. Descriptions of obsolete manufacturing processes as on pages 113, 114 and 404 can also be omitted.

Some statements require correction; *e.g.*, "When Mercuric Oxide is heated in a test tube, mercury is found in the bottom of the test tube" (p. 86). The list of elements on pages 76–80 gives the reader an impression that there are 96 known elements. One reads on page 103 that the substance which sustains all animate beings is a *mixture* of carbon, hydrogen, oxygen and nitrogen, and on page 135, that, by passing an electric current through *water*, the process of electrolysis can take place! There is no use copying the physical constants as given in the English books written for Latitude of about 45°. Solubility data should be given upto 30° C. for the average Tamil Nad environment and not stop at 20° C. as in English books (see pages 204, 422, 574 and 762). There are four pages of errata in the book, but the list is still incomplete. The whole book requires careful revision in detail; this is perhaps inevitable in a pioneer work and our observations have been directed by a desire to see a good book made better in its next edition which should not be long in coming if the change in the medium of instruction is practical politics, and not a distant ideal in the educational world.

K. C. VEERARAGHAVA AYYAR.

Bibliography on Cold Resistance in Plants. (Imperial Bureau of Plant Breeding and Genetics, Cambridge), 1939. Pp. 22. Price 1*sh.* 6*d.*

The economic importance of cold resistance in plants has long been recognised by growers who know from experience the havoc that may be done to a susceptible crop as the result of a single frosty night. Recently its importance has increasingly drawn the attention of breeders and physiologists, and there is now a considerable literature dealing with the problem of cold resistance. The Imperial Bureau of Plant Breeding and Genetics in issuing this compilation has rendered a service to plant breeders which will be much appreciated. In addition to references to papers on breeding for cold resistance and the genetical aspects of the problem, others of a more general nature bearing on the physiological nature of resistance and on problems of technique are included. The usefulness of the bibliography has been enhanced by the classification of the references under appropriate subheads and by the indication, in the case of papers which have been abstracted by the Bureau, of the relevant Volume and Abstract number in "Plant Breeding Abstracts".

B. P. P.

Field Trials: Their Lay-out and Statistical Analysis. By J. Wishart. (Imperial Bureau of Plant Breeding and Genetics, Cambridge), 1940. Pp. 36. Price 2*sh.* 6*d.*

In this bulletin we have yet another valuable publication from this well-known authority on agricultural statistics and field experimentation, dealing with modern methods of laying out field experiments and their statistical analysis and interpretation.

Stating briefly the necessity for field trials as they are conducted to-day, the author explains in a concise and simple manner what is meant by the experimental error and the test of significance. He then deals with the methods of lay-out, the analysis of the data and their interpretation, involved in the randomised blocks and Latin Square methods. Chapters on multiple factor and split-plot experiments, confounding and the testing of a large number of varieties at a time, introduce the beginner in an easily understandable way to the most recent developments in field experimentation. The notes on calculation in the chapters on randomised blocks and Latin Squares are a useful feature.

The bulletin should prove a great help to those engaged in conducting field experiments of various kinds, in India and elsewhere.

B. P. P.

Hilsa Investigations in Bengal :

(1) "On Some Early Stages in the Development of the so-called Indian Shad, *Hilsa ilisha* (Hamilton)." By K. Krishnan Nair. *Records of the Indian Museum*, 41, Part IV, pp. 409–18 (Calcutta, December 1939). (2) "Further Observations on the Bionomics and Fishery of the Indian Shad, *Hilsa ilisha* (Hamilton), in Bengal Waters." By Sunder Lal Hora and K. K. Nair. *Records of the Indian Museum*, 42, Part I, pp. 35–50 (Calcutta, March 1940).

Mr. Nair's paper is devoted to an account of the early post-larval stages of the Indian Shad or as it is more popularly called, the *Hilsa*. Since this fish is of considerable economic importance it follows that a full knowledge of its development is desirable. The *Hilsa* is an anadromous fish, that is one which ascends from the sea into tidal or fresh waters in order to spawn. Experience in Europe and America tells us

that anadromous fish are particularly liable to suffer from the effects of overfishing. Whether this is now, or is likely to be the case in the near future, to be feared in the case of the *Hilsa* is not yet clear, since reliable statistics are wanting. Should the *Hilsa* be declining as the result of overfishing, there are several remedial measures which might be applied, such as artificial hatching, a close season or regulation of the fishery. But it is obvious before we can discuss measures of control or amelioration we must know about the life-history of the fish. And this is precisely why papers such as this of Mr. Nair are of use and importance. The early post-larval stages of the *Hilsa* are described in some detail and the work has been carried out with strict attention to the most modern methods applied in this class of research. The material was obtained from the Pulta Waterworks, Calcutta, where recently these fry were first discovered by Dr. Hora.

While much of the detail is perhaps of interest to specialists, it must not be forgotten that a fish of great economic value is dealt with, that the methods of investigation are modern and sound, and the results of value. In the opinion of the reviewer this paper reflects credit not only on the author but also on the Zoological Survey of India under whose auspices it is published.

The second paper is a continuation and expansion of the one by Dr. Hora on the spawning grounds and bionomics of the *Hilsa* which was reviewed in *Current Science* in November 1938.

At the outset it may be said that the authors have succeeded in writing a paper which is both important and interesting—a rare combination in a scientific paper. Often an important paper is spoilt by its style and arrangement; on the other hand, many interesting papers are for specialists only.

We have here a complete and up-to-date account of one of the most valuable, if in fact it is not the most valuable, of Indian fish, and moreover a fish whose life-history has until quite recently been a complete mystery. The first important step in the solution of this mystery was the discovery by Dr. Hora of the larvæ of the *Hilsa* at the Pulta Waterworks of the Calcutta Corporation in November 1937, and also at Nawabgunge in the same cold weather.

Following up this discovery Dr. Hora and Mr. Nair were able to clear up many dubious or unknown points in the *Hilsa's* life-history. Previous investigators were led astray through relying too much on the bionomics of anadromous fish in other countries. In Great Britain, Europe and America fish which move up from the sea to tidal or fresh waters (i.e., which are anadromous) do so for the purposes of spawning only and not for feeding as well. Consequently they do not ascend rivers beyond the place of spawning. In 1918 Southwell wrote:—

> "Very large numbers of *Hilsa* have been examined. In every case the stomachs were found to be empty and much contracted. This is a feature which *Hilsa* shares with other anadromous fishes all over the world."

British anadromous fish such as the salmon, sea-trout and smelt spawn in definite and restricted areas; the salmon as far upstream as it can get and the smelt in a narrow and confined area at the head of tidal waters. It was assumed, wrongly as we now know, that the *Hilsa* would have habits somewhat similar to these British anadromous fishes, but it is now conclusively clear, through the researches of Dr. Hora and Mr. Nair, that the *Hilsa* can and does spawn at widely different places in the Ganges and Brahmaputra watersheds, from the tidal waters upwards. This paper must be read to be appreciated. The bald summary here can hardly do it justice.

In the first place the investigations at the Pulta Waterworks are described, together with the breeding season and rate of growth of the larval stages. To supplement the Pulta researches collections were made at various points in the Hooghly and other waters at various seasons of the year; and young stages were sought in the markets. It is found that the *Hilsa* breeds in the river throughout the year, the peak period being in July–August and a second lower peak in May. These peak periods correspond with the flooding of the river owing to the monsoon and the nor'westers.

The rate of growth of the *Hilsa* is rapid, fish from ten months to a year old are about one foot in length.

To supplement the information collected locally, collections were made in East Bengal by Mr. Datta who was successful in obtaining young *Hilsa* in the river at Gazalia and Galachipa and in the markets at Patuakhali

and Narayangunge. Examination of the adult specimens shows that the *Hilsa* probably breeds at Pātuakhali in February, as it does in the Hooghly river. The presence of mature males at Chandpur in February points to the same conclusion.

The authors then deal in some detail with the up-river migration of the *Hilsa* obviously a point of considerable value to the fisheries. They claim, and we think with justice, "our investigations have definitely established that migration is for spawning purposes", but they are careful to add that still more research is needed to fill up gaps in the narrative.

Another section of the paper deals with the *Hilsa* fishery in Bengal and there are interesting comments and reflections on the fluctuations of the fishery. Like all fisheries, that for the *Hilsa* is subject to annual and seasonal variations. An interesting theory put forward is that there is a five-year cycle in the fishery, but unfortunately the statistics of the fishery are not sufficiently extensive or detailed to prove or disprove this theory.

Another question is: Are there two or more races of *Hilsa*? Are the fish which spawn in the Sunderbans and those which spawn up the Ganges beyond Monghyr distinct races, and if so, can these races be distinguished apart; as the races of herring (which like the *Hilsa* is a Clupeoid fish) are in Europe?

The reviewer thinks that in some cases too much has been made of the racial differentiation of one single species of fish such as the herring, but on the other hand it is a question well worthwhile investigating in the case of the *Hilsa*. The *Hilsa* sent to the Indian Museum by Prof. Bhattacharya from Allahabad were remarkable as they were marked with black spots, a characteristic feature of the young. It is impossible to give a complete resume; the value and utility of the paper can only be properly realised by or through a personal perusal. With a fish of such handsome appearance and delicious taste one does not need to be a zoologist to learn about its bionomics and life-history; and Dr. Hora and Mr. Nair are to be warmly congratulated not only on having such a valuable subject to investigate but also with the skill and ability with which they have carried out the work.

J. T. J.

One Day Telleth Another. By Stephen A. Ionides and Margaret L. Ionides. (Edward Arnold & Co.), 1939. Pp. 324. Price 10*sh.* 6*d.* net.

When Socrates proposed to Glaucon to make Astronomy their next study, Glaucon agreed, for a working knowledge of the seasons, months and years is beneficial to everyone, to commanders as well as to farmers and sailors. Thereupon answered Socrates: "You make me smile Glaucon. You are so afraid that the public will accuse you of recommending unprofitable studies."

And indeed Astronomy is not an unprofitable study. But is it of much profit as set out in this intriguing book? Can we call it Astronomy? Hardly. Or the history of Astronomy? Scarcely. Or the romance of Astronomy? Perhaps. What is certain is that it is a book written by leisured people for people of leisure. Are any such in India? (leaving aside, of course, Rajahs and Princes, whose multifarious occupations will leave no time to enter the by-ways of astronomical lore). We doubt it. Hence, while we wish the book good luck in the country of its birth, we do not feel justified to recommend it to Indians.

D. F., S.J.

A Short History of Science. By F. Sherwood Taylor. (The Scientific Book Club, London), 1940. Pp. xiv + 320, 14 plates and 36 figures. Price 3*sh.* for members.

At a time when passions run high, nationalism becomes narrow and selfish interest renders people blind to the common good of mankind, a history of science is a particularly useful publication. Whatever differences there may be in the type of problem that interests people of different races or regions, there can be no doubt that the discovery of truth is the object of science and its method such that no one should have any scruples in giving assent to its findings. Science is also universal in the sense that it is not the creation or the exclusive preserve of any one nation. Different peoples have, at different times, contributed to its development. Although the nature and the extent of this contribution have varied with the genius and the predilection of various peoples, it is a fact that all civilised nations have contributed and are contributing to its growth. The book before us gives us a clear picture of this cosmopolitan character of

science and shows how the efforts of various peoples have brought it into being and are helping in its growth. It also shows how there were no separate divisions in early science, and, how even now, when its complexity makes specialization inevitable, the application of the methods and results of one branch leads to new developments in another. The book ends with a note of doubt as to whether the regularity of its picture of the world is not merely due to the method it adopts, and also as to its applicability to the non-material part of our experience. However, a perusal of the book is a good remedy for any tendency towards a prejudiced and narrow outlook on life and we must congratulate the *Scientific Book Club* on making such a lively book available to the general reader at such a low price. A number of quaint illustrations and extracts from ancient books adds to the peculiar charm of Dr. Taylor's treatment which we have learnt to admire in his *"World of Science"*. We wish that everyone should read this history of science and ponder over its lessons. T. S. S.

The Fight for Life. By Paul De Kruif. (The Scientific Book Club, London), 1940. Pp. 320. Price 3*sh.* for members.

This is a fascinating volume which narrates in vivid language the story of man's ceaseless fight for life against the numerous and deadly diseases which challenge the right of man to live. Heavy tolls of life are taken by maladies which need no longer afflict humanity, by diseases whose incidence and spread is due to ignorance, poverty and malnutrition. There are, of course, other diseases like infantile paralysis which afflict humanity irrespective of their social status —the rich and the poor alike.

The scientific investigator, in dealing with diseases resulting from poverty and malnutrition is faced with the problem of not only finding a remedy but also of one which is "dirt cheap", if it should have any practical application. This is the kind of problem with which investigators in India are confronted.

The second part of the volume consisting of four chapters deals with the fight against "maiming death"; this should be read by every scientific investigator; the struggle, still in progress, constitutes one of the most determined and romantic fights against infantile paralysis. The scientific investigator had his moments of defeat and depression; this elusive and mysterious disease has baffled and misled him on several occasions but the fight continues with renewed vigour and energy.

There is a good deal in this volume which will appeal to administrators and philanthropists of this unfortunate and disease-ridden country, which has yet to witness the kind of successful fights against death, waged in Europe and America. We hope that this extremely interesting and low-priced volume will be read by a large circle of men and women in this country. M. S.

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(1) Guide to the Archaeological Galleries. By F. H. Gravely and C. Sivaramamurty. (Madras Government Press), 1939. Pp. 48. Price Re. 0–8–0.

(2) Illustrations of Indian Sculpture. By F. H. Gravely, and C. Sivaramamurty. (Madras Government Press), 1939. Plates XLV. Price Rs. 1–8–0.

These publications are welcome not only to visitors of the Museum but to students at large. The authors give an introduction to the South Indian Temple, Architecture, Sculpture and Iconography. It is based on archæological tradition which is, on the whole, safe to follow. We are thankful for the introduction of a section on ancient Indic culture. But the 'Mohenjo-Daro civilisation' can no longer be described as 'pre-Aryan'. Nor could evidence be cited for the view that Asoka brought his skilled sculptors from Eurasia. Harappa statuary bespeak an antiquity for stone sculpture in India, and it can no longer be held that 'Buddhists and Jains were the first to develop sculpture in stone'.

The sketch will serve to educate the general reader, and deserves to be translated into Tamil and Telugu for the benefit of the museum-going thousands. The illustrations are well turned out, and the price has been fixed low so as to place these pamphlets within the reach of all.

S. V. V.

PROBABILITY AND FREQUENCY

Probability and Frequency. By Professor H. C. Plummer, M.A., F.R.S. (Macmillan & Co., Ltd.), 1940. Pp. xi + 277. Price 15*sh*.

THE world is rapidly coming to realise the immense role played by "chance" in all matters commercial, social, political or scientific. In other words, "indeterminism" seems to have come to stay as an organic part of our civilisation and culture. Though as Bertrand Russel put it "chance" may be negation of all laws, mathematical acumen has been sharp enough to penetrate beneath the apparent lawlessness or randomness and evolve a working set of rules for our guidance. Theories of Probability are the result of mathematical studies of "chance events". Many text-books on Probability and Statistics have been written with specific applications to economics, business statistics, medicine, biology, and education, in order to cater to the needs of non-mathematicians interested in these fields. They cannot therefore afford to put in sufficient mathematics. Here we have a book by an eminent astronomer boldly coming forward to give the necessary mathematical background to the subject without any fear of persons unsophisticated mathematically. The author is however rather modest in regard to his aim. His ambition is only to provide an introduction to the general ideas of the subject from a simple mathematical point of view, and refers to his work as too "slight" to need a bibliography. Perhaps the consciousness of the author that he is not making a novel contribution has affected the exposition which is very much condensed and not quite easy to follow, explanations in worked examples being of the tabloid form.

The treatment of probability is designedly of the usual text-book variety based on the Laplacian doctrine of exclusive and exhaustive alternatives of equal probability and therefore makes no mention either of modern theories or criticisms of the classical school like those of Richard von Mises, H. Cramer, A. Kolmogoroff or Maurice Frechet. The author believes, in J. M. Keynes' manner, that what he calls Bernoulli's Capital theorem which is deducible from the Laplacian definitions gives a precise meaning to the relative frequency definition originally due to Leslie Ellis (*vide* p. 92, "A Treatise on Probability" by J. M. Keynes) but here attributed to Chrystal. The first two chapters deal with probability and introduce the reader to almost all the simple and noteworthy problems and theorems due to Huyghens, Montmort, Tschebyscheff, Bernoulli, Bertrand, Burnside, Poincare, Crofton, Buffon, and others. They contain also some incidental and necessary pure mathematics, Stirling's approximation to factorial n, Euler's Gamma and Beta functions, and Dirichlet's integral. The introduction to *a posteriori* probability and the theorem of Bayes is remarkably clear and leads on to a suggestion of a sort of fiducial probability, the range to be attributed to the probability to be inferred when the frequency is given. The discussion is enlivened by such humorous touches as the following:

> "Not even the most primitive mind contemplates a Twilight of the Gods, when the sun will rise on week-days only; it is doubtful if the Eskimo thinks of the play of chance when the sun remains above or below the horizon."

In support of the urgency of Bayes' rule, it is asserted that any justification must be found in the absence of any alternative way of grafting a few isolated facts on the tree of ignorance. Every meteorologist knows of occasions when an answer must be found and the best, if not the ideal answer, must be given, provided it shall not violate the established principles of probability (pp. 115 and 116).

It is probably not too much to affirm that nowhere has a student of probability been warned against the misuse or abuse of the ideas of continuous probability in relation to *a posteriori* probability as in para 122 of this book. The real obstacle to the application of the theory lies in the uncertainty regarding the *a priori* probability. When this law of probability is known, the *a posteriori* probability can be calculated in the light of observed facts on principles which are sound enough. The result is a modified law of probability, which virtually represents the probability of a probability or probability at second hand, as it were. As

a measure of frequency this inverse probability or probability of causes must be regarded as inferior to a more direct determination based on fuller knowledge. But only too commonly a knowledge of the *a priori* probability is entirely absent. It is then only possible to make some hypothesis to supply the deficiency. The assumption should be as reasonable as may be, and should at least cover all conceivable possibilities. It may then be fairly hoped that the result will represent a tolerable approximation to the truth.

The third chapter deals with the theory of errors in which the astronomer feels naturally at home. Prof. Plummer does not admit the validity of the deduction of the normal law from the assumption that the errors of observations are the result of unlimited independent sources (p. 132). On the other hand, in such typical cases as the astronomical observations of position, the law represents the errors of a good observer in favourable circumstances. While the law admits the possibility of errors larger than can occur, it tends to underestimate the probability of errors which do occur. However, the astronomer has adopted it on account of the practical advantages it offers. After studying the error functions in some detail, the author proceeds to expound the mathematics of the Method of Least Squares deriving formulæ for the standard deviations of the unknown. A note of warning is sounded that when everything (mathematically) possible has been done, it must not be regarded as surprising when the probable error of a determination is proved to be exceeded several times by the result of a later investigation (p. 166). The mathematical method gives a measure of the self-consistency of the solution rather than that of the true accuracy of the observations. We are told that astronomers' troubles lie in other directions than mathematical, such as inadequacy of the number of observations, choice of appropriate weights to be attached in the combination of observations from different sources and the presence of systematic error (p. 177).

The last two chapters, (four and five) deal with Statistics proper. Chapter four treats of curve-fitting by the methods of Fourier analysis and Pearson's differential equations. Hardy's method of summation is expounded for the calculation of moments of different orders. Chapter five is headed "correlation" which properly applies only to the first half, giving an account of the well-known Bravais' method for the normal distribution of points in two and three dimensions. We must be grateful to the author for devoting the rest of the chapter to the proofs of results which are usually merely enunciated in statistics text-books on account of the mathematical difficulties involved. But they are fully faced here and we get a mathematically satisfying discussion of Pearson's root-mean-square contingency, and the frequency distributions of chi-square, standard deviation, Student's ratio and Pearson's correlation coefficient. The dispersion of the correlation coefficient is also included. In regard to these difficult distributions, it may be remarked that a precedent had already been set up in their inclusion in books on probability by H. Levy and L. Roth (pp. 185–89) and J. V. Uspensky (pp. 331–46). However, the chi-square distribution makes its first public appearance in full mathematical robes only in the present text.

On the whole, Prof. Plummer's book will appeal greatly to all persons whose mathematical equipment is more or less of the Honours standard of an Indian University. We have no hesitation in recommending it to every mathematical aspirant, student or teacher, who wants to enter into the new discipline which is coming to have an ever-expanding field of applications.

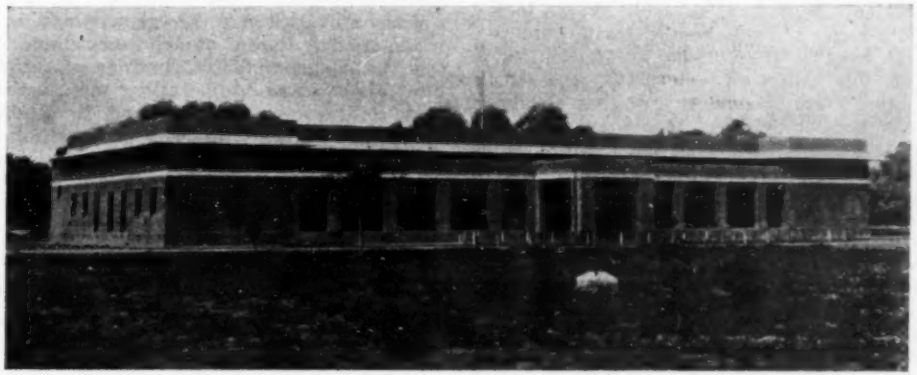
K. B. MADHAVA.

IMPERIAL VETERINARY RESEARCH INSTITUTE

Animal Nutrition and Poultry Research Sections

TWO important additions to the Imperial Veterinary Research Institute have recently been officially opened by His Excellency the Viceroy. These are the Animal Nutrition and Poultry Research Laboratories, erected last year at Izatnagar. The original laboratories of the Imperial Institute are situated at Mukteswar in the Kumaon hills, where, the climatic conditions being considered more suitable than those of the plains for the carrying-out of the finer operations of biological research, the Institute was founded in 1893. Its purpose was then defined as the investigation of the diseases of domesticated animals in India and the preparation of agents for their control. In 1901, land was purchased at Izatnagar near Bareilly to provide for the carrying-out of certain experiments in the winter months. Successful researches at Mukteswar led to the manufacturing for sale of various biological products for the prevention and cure of animal diseases. As the demand for these rapidly increased, it was decided in 1913 to open a section for the production of antisera on the Izatnagar site, where more space was available for development than at Mukteswar.

With the gradual establishment of some measure of control over the contagious diseases that had previously proved so great a scourge to animal husbandry, the wider aspects of veterinary work in India became more apparent. Particularly was this the case in regard to the recognition of the necessity for the study of animal nutritional problems. As early as 1923, a Physiological Chemist's Section was opened at the Imperial Institute of Animal Husbandry and Dairying, but, as it was later on felt that more space was necessary for this work and that Bangalore was somewhat isolated from cognate research, it was decided, in 1938, to transfer this section to the Imperial Veterinary Research Institute and to build new laboratories for its accommodation at Izatnagar. At about the same time the Imperial Council of Agricultural Research agreed to give a grant to the Imperial Veterinary Research Institute for the establishment of laboratories to be devoted to research into questions concerning poultry.



Poultry Research Section

The buildings, constructed at a cost of about Rs. 8 lakhs as a result of these decisions, comprise the Animal Nutrition and Poultry Research Sections. The main Animal Nutrition building contains several Physiological laboratories, where various techniques are employed in the study of the physiological effects induced by different

diets; Analytical laboratories; a Pathology laboratory; a Biochemistry laboratory; a Spectroscopic room; a Students' laboratory; a Special Work room; a Small Animals' room for small animal deficiency experiments; offices and an excellent library of works on nutritional science. The laboratories are well equipped with mills, gas and electric ovens, incubators, refrigerators, sterilizers and all other necessary apparatus. Near the Animal Nutrition building are Animal Nutrition stalls, a weigh-bridge, a post-mortem room and also a farm plot for experimental work on fodders. The Poultry Research building comprises a Poultry Marketing laboratory; an Egg Grading and Candling room; an Industrial Chemical laboratory; Pathological laboratories; a Biochemical laboratory, as well as a Library and a series of cold chambers with temperatures ranging from 0°–60° F. In connection with this aspect of veterinary research, a Poultry Farm on modern lines has also been developed for breeding, incubation and feeding experiments, the brooder house alone having accommodation for 1,500 chicks under electric hovers, while there are runs for 2,000 adult laying birds and the necessary replacement of young stock.

Research work on animal nutritional problems is of undoubted importance to India. The majority of Indian cattle are unthrifty and emaciated, among them mortality is high, sterility common and the milk yield of cows is low, all of which conditions point to malnutrition as probably the greatest single factor in their causation. Any improvement in the economic position of India and in the feeding of her people must largely depend upon raising the quality of her cattle and animal population, since India is predominantly an agricultural country and since food-stuffs of animal origin are now-a-days recognised as essential to human health. This improvement in animal husbandry must be mainly dependent upon the better feeding of livestock. It is, however, no easy task to provide fodder adequate both in quantity and quality. The husbandman is often hard pressed to find sufficient food for himself and it naturally follows that his animals must often be on very short commons, if not actually verging on starvation. It must, however, be realized that any expenditure on fodder for his animals will be more than repaid in larger supplies of milk, butter, meat and eggs. The first effort of the research worker must, therefore, be directed to ascertaining the best possible use to which the food resources, which are or could be economically produced from the available land, can be put.

With regard to this problem, the Animal Nutrition Section aims at conducting experiments upon the different kinds of fodder available in India, their areas of cultivation, their food value and the methods of preserving the excess fodder available during certain seasons of the year for use in times of shortage. Farm experiments will also be undertaken on indigenous and imported fodders with a view to improving the yield and quality of existing pastures and to discover the nutritive value of grasses at different stages of their maturity.

Another nutritional problem which will be dealt with is that of deficiency diets. It is already known that a shortage of certain minerals or vitamins in rations may lead to various disorders, such as bone diseases or blindness. It has also been shown that in many localities the necessary minerals are lacking in the soil and, therefore, also from the crops grown upon them. An analysis of the mineral contents of fodders, is consequently, to be undertaken and a map of India to be prepared, indicating the localities where pastures are deficient in minerals, with the intention of demonstrating their relationship to the prevalence of certain diseases in those areas. Experiments will also be conducted to find how best these deficient diets may be supplemented to remedy their defects.

Digestibility and utilization experiments will be carried out with food-stuffs of all-India importance to determine the maintenance requirements of different types of animals; to discover the relationship between diet and milk, wool, hide or skin production, growth and reproduction; and to study the physiological significance of the interrelation of food-stuffs. Further research will be directed to ascertaining the part played in disease by underfeeding and by improperly balanced or deficient diets; and, in the realm of toxicology, it is hoped to conduct a systematic study of plants known or suspected to be poisonous to live-stock and the effects of the ingestion of these upon animals.

The Poultry Research Section represents a direct attempt to develop a curiously

neglected side of Indian agriculture. Poultry keeping could and should be an important addition to agricultural activity in a country, where the uneven distribution of crops enforces long periods of comparative idleness upon the farmer. Moreover, it has been clearly demonstrated that, intelligently developed, the industry could prove not only of great pecuniary benefit to the husbandman but of considerable economic advantage to the country as a whole. The indigenous fowl at present lays too small an egg for it to command anything better than local markets but the production of larger eggs would open up lucrative world markets to Indian produce.

The immediate policy of this Section is to build up a sound poultry stock which will provide material for research in various spheres, such as disease, genetics and marketing. Losses from disease among poultry are exceptionally high in this country and have, until now, not received the attention their importance merits. In view of the highly technical nature of disease research in poultry, an officer has been sent to England for a two years' special study course and it is hoped, on his return, that it will be possible to get to grips with these problems as they affect India and eventually to evolve adequate measures for the control of those devastating epidemics that periodically exterminate practically the entire fowl populations of different districts.

With a view to improving the type of fowl bred, experiments will be undertaken to determine optimum methods of incubating, brooding, rearing and feeding. Studies will also be conducted on the growth rate and rearability of imported hens, such as White Leghorns and Rhode Island Reds and a comparison of the data thus acquired made with known conditions regarding Deshi fowls. It should, thereafter, be possible to determine the type of bird best suited to Indian conditions. As the village producer is, and must remain, the backbone of the industry, particular attention will be paid to evolving methods of production that are suited to village conditions.

With a view to giving an impetus to the poultry industry as a whole, investigations will be carried out upon such matters as the grading of eggs for Indian and foreign markets; the preservation of eggs by pickling, cold storage, "guaranizing" and other processes; the preparation of table poultry; the best methods of packing eggs and poultry; and the possibility of introducing such articles as egg powder and egg pulp to the Indian market.

In addition to its research activities, the Poultry Department will act as a central information bureau in regard to poultry development and to all technical matters. A Library containing a representative range of scientific text-books, periodicals and bulletins is being built up, which should in time form a valuable collection on the various aspects of poultry rearing and marketing.

As His Excellency the Viceroy remarked in his opening speech:—"It is a matter of common observation that in the medical profession the progress of attention has been from cure of disease to prevention of disease and then to the establishment of health. ....The trend of veterinary activity presents a good example of this progress .... The third stage in the sequence .... (is) the establishment of health, which means, for veterinary purposes, the establishment of animal well-being and of the general conditions, which will strengthen the animal's resistance and improve its quality. The Animal Nutrition building represents, as it were, the realisation in brick and mortar of the full recognition of this important branch of veterinary science."

F. C. MINETT.

INDIAN AVIATION MAPS

THE subject of maps as used in aviation and the kinds best suited, more particularly with reference to India, was discussed very fully in the serial "Shall we learn to fly" which appeared throughout 1939 and early 1940 in "*Mysindia*", published in Bangalore. There it was observed that of the various scales published, the most generally suitable for aviation had been found to be the scale 1/1,000,000 or 15¾ miles to the inch, called for short the million scale, the maps being known as "million maps"; though some aviators prefer the next smaller scale, 1/2,000,000, since one sheet of the same size in that scale covers four times as much area of country, and hence fewer sheets are required to be carried around and less frequent manipulation is called for. The Survey of India publishes on this smaller scale an excellent series called the "Southern Asia Series". It is a layered series and that in a very effective range of colours.

However, to return to the million maps: The Survey of India publishes two great series of these, the earlier established "India and Adjacent Countries Series" and the later, but by no means to be inferred more up to date, "Carte Internationale du Monde Series", both on the same projection. The former are square sheets with the mapped area measuring 4 degrees of latitude by 4 degrees of longitude and the latter are oblong sheets with the mapped area measuring 4 degrees of latitude by 6 degrees of longitude (and a degree of latitude equals 60 sea miles or 69 statute miles). The former series is, or rather was, published in two editions, the political and the layered, the layered being now, alas, out of print. The latter series, the "International" for short, is in a layered edition only, but what a contrast to the other layered edition! And by layered, perhaps, it would be as well to explain, is meant layers of colour, apparently superimposed, to indicate the height of the ground above sea-level. Altogether cruder is the International series, in which a flat green is used for land at or near sea-level and a flat brown for everywhere else; with very little to indicate the presence of great hills and nothing at all to indicate their shape; or even the mere presence of little hills. Actually the green and the brown are graded in various shades, lighter to deeper, but this is scarcely apparent and one is led to suppose, unless one looks very closely indeed, that India is one vast undifferentiated table-land of unspecified altitude surrounded by a fringe of dead level maritime plain unrelieved by any hill. And this is the map series chosen as the basis for India's aviation maps. Indeed it is simply *hey presto!* by the addition of a few symbols to indicate landing grounds, aerodromes, factory chimneys and so forth (which features of course are only too apt to continue multiplying after publication of the map in which they appear) that this series is transformed into aviation maps; for in all other respects it is the International Series and nothing more—with heights given in metres too, whatever a metre may be. Can any honest Briton or Indian be expected to know. Anyway the altimeters on aeroplane dash boards give heights in feet—in British and American aeroplanes at all events.

As regards the India and Adjacent Countries Series, the now extinct layered edition (where specimens of the maps are still to be found) is a veritable work of art, presenting as it does the illusion of an exquisitely modelled relief map, every hill and range whether big or small boldly standing out in its natural shape as actually seen from the air, so cleverly has the contouring and shading been done; and the choice of colours for the layering has been a stroke of genius, revealing as it does at once the altitude above sea-level unmistakably of any part of the country and making of each sheet a picture pleasing enough to be framed and hung on a wall. And now all that labour and ingenuity gone into limbo. A regular decline and fall. As the early Hebrews used so dejectedly to moan, "Ichabod", meaning "the glory hath departed". The political edition is (or was) an exact replica of the layered edition except for the absence of layer colouring and for the substitution of political boundaries in yellow. The contouring and shading of hills is (or was) absolutely identical, but in other respects it is a white edition in contrast to the other which was essentially a coloured edition. Both these editions of the India and Adjacent Countries Series are vastly superior to the Internaticnal Series from the point of view both of the aviator and of the man down below, particularly of course the very picturesque extinct layered maps, but the white maps are ideal for enabling track lines to be ruled in pencil and to remain visible thereafter; and heights in both are given in familiar feet.

Alas though and here the story turns sombre again. Once more one groans "Ichabod". Have we not as children played that pencils-and-paper game in which someone draws some simple sketch, *e.g.*, of a pig, and passes it along to the one next alongside to copy and to pass the result along again to be copied by the next one and so on. The final picture was rarely recognisable as a copy of the first. So with map copyists as million edition passes to million edition, though with not quite so appalling result. New features it is true are entered such as roads and railways that have been built since the publication of the previous edition, but the old original features suffer. Rivers and streams lose their characteristic bends, some even their very character itself, roads become rivulets, rivulets join the main stream at the wrong place, lakes lose their characteristic outlines and some vanish altogether, contours lose their careful precision and those of small hills collapse into vague hatchuring, and so on the sad tale goes. This fate has not befallen the maps of the layered edition of the India and Adjacent Countries Series, simply we must suppose because it was decided long since to discontinue its publication, but it has befallen the maps of the political edition and, to an even greater

extent, those of the International Series. The new political maps are nothing like so good as the old, but nevertheless they are still greatly to be preferred to the maps of the International Series; and after all if an aviator wants his maps to show aerodromes and things there is nothing to stop him from referring to sources of information and entering the symbols himself with his own hand when he has a few moments to spare. And for the aviator who is a collector of rarities there may yet be available in odd and musty map stores copies of the old layered and political editions, now so definitely qualified to be included in the category of early treasures.

To come now to cases and to bring the story nearer home.

(i) Madras is situated at a point on the coast south of which for 50 miles sprout a profusion of small isolated hills anything up to 500 feet high, and north of which sprouts but one small hill in 150 miles. The erring aviator making for Madras either from inland or from out to sea and striking the coast within 50 or 60 or 70 miles of Madras if he be aware of the topographical situation as just described is informed promptly thereby in which direction to turn in order to reach Madras. The India and Adjacent Countries Series map, however recent the edition, shows the situation as described. The International map shows a complete absence of hills equally north and south of Madras; and remember, the International map is the aviation map. (ii) An isolated and prominent hill, a thousand feet high, near Wandiwash, a landmark for miles, is not shown in the International map. Nor are the very considerable hills near the Madras Civil Aerodrome. Of what use then to go to the labour of indicating factory chimneys? (iii) Coming from Calcutta an aviator new to the route found himself to his bewilderment amongst isolated abrupt hills in the vicinity of Cuttack where his map showed none. It was an International map. (iv) Lastly it is illuminating to observe how the two series deal with Kolar Gold Fields, the truth to detail in the one and the extreme casualness to say the least displayed by the other. With aeroplanes and all their accessories steadily improving as the years roll on it is depressing to reflect that Indian maps available for aviators should be so definitely deteriorating; apart, of course, from the pretty symbols to show what most aviators in India anyhow know already, *e.g.*, that there is a civil aerodrome at New Delhi, equipped with all modern conveniences, that there is an R.A.F. landing ground at Bellary and so forth.

Actually the aviation maps for Great Britain and doubtless some other parts of the world are very good indeed. In them colouring is employed not for layering but to imitate actuality, *e.g.*, dark green for woods, and care is taken that the shape of each wood shall be accurately entered and that the map shall be in every way as clear a picture as possible of what the aviator will see. This sort of thing would be too big a task altogether for India where forests and scrub are of vast extent and without either clear definition or shape, merging as they do by gradual degrees into cultivation or wasteland, but on the other hand the old layered edition of the India and Adjacent Countries Series, if brought up to date and not spoilt in the process by slipshod copying, would make an ideal aviation series. In the meanwhile aviators will do well to avoid the official aviation maps and choose the political maps of the India and Adjacent Countries Series instead, which for all their deterioration of late years are really quite good enough.

VITAMIN E—A SYMPOSIUM

Vitamin E—a Symposium. The Food Group (Nutrition Panel). (Society of Chemical Industry, London), 1939. Pp. viii + 88.

SINCE the discovery of Vitamin E in 1922, there has been a very large volume of work on the various aspects of the vitamin, chemical, analytical, physiological, clinical and therapeutical. The Nutrition Panel of the *Society of Chemical Industry*, organized a symposium in April 1939, before which some of the most prominent workers in the field, have presented their contributions. The present volume representing the proceedings of the symposium, constitutes a valuable summary of our knowledge in a highly important biochemical field. Special attention should be invited to the contribution by Professor Karrer, who deals with the synthetic analogues and homologues of Vitamin E and discusses the stability of tocopherol and tocopherol esters. Part II of the volume which deals with the physiological action of Vitamin E and the consequences of Vitamin E deficiency, will prove intensely interesting and illuminating to the medical profession who have to deal with cases of sterility. Veterinary doctors and animal breeders will find plenty of useful and practical information in Part III of the volume which is devoted to a discussion of the clinical and veterinary uses of wheat germ oil and Vitamin E preparation.

The *Society of Chemical Industry* should be congratulated not only for organizing this symposium but also on the production of this volume which will command the attention of a wide circle of investigators and which will stimulate further research on this important vitamin. M. S.

CENTENARIES

Chambers, Ephraim (1680–1740)

EPHRAIM CHAMBERS, an early English encyclopædist, was born of a farmer at Kendel in 1680. Having received his education at Kendel and London, he apprenticed to a map and globe-maker and while thus occupied he took up the compilation of a cyclopædia on a larger scale than that of John Harris's *Lexicon technicum* (1704).

THE CYCLOPÆDIA

Chambers published his *Cyclopædia: or an universal dictionary of arts and sciences, etc.*, in 1728; he endeavoured to connect the scattered articles relating to each subject by a system of references based on a specially devised scheme of classification and "both to treat them as so many wholes and so many parts of some greater whole". Immediately after its publication, he was made a Fellow of the Royal Society. It went through several editions and translations. The sixth edition (1750) contained two supplementary volumes compiled by Sir John Hill, the botanist, and George Lewis Scott, the mathematician. It formed the basis of the more extended cyclopædia of Rees which was completed in 45 volumes in 1819. It may be said that Chambers's work originated all the modern cyclopædias.

Chambers lived to the last the life of a recluse and a hard student, reading and writing from morning to night almost without intermission. A person who was his amanuensis for six years is said to have stated that "he transcribed for him and took down from his dictation in that space of time, not less than twenty large folio volumes as those of his *Cyclopædia*".

Chambers died at Islington, May 18, 1740.

Rockwell, Alphonso David (1840–1933)

ALPHONSO DAVID ROCKWELL, an American physician, was born in New Canan, May 18, 1840. He began his medical studies with a local practitioner and having seen service in the army for a few years settled in New York in 1865 for practice.

ELECTROTHERAPEUTICS

In 1866, he collaborated with George M. Beard in the investigation of the therapeutic applications of electricity. At this time electricity was not used to any extent by physicians in the United States and very little elsewhere. It is their pioneer *Medical use of electricity* (1867) which created general interest in the subject. In 1871 they brought out their *Practical treatise on medical and surgical uses of electricity* which went through eleven editions and several translations. Here they described exhaustively and with illustrative case reports the *modus operandi* of general electrization which they had been the first to investigate. In 1886 Rockwell was made professor of electrotherapeutics at New York Postgraduate Medical School. He was also elected President of the American Electro-Therapeutic Association.

ELECTRICAL CHAIR

When the New York State law was enacted changing the method of legal execution, Rockwell was chosen as one of a committee to advise the State upon the apparatus known as the electrical chair. He was a witness of some of the earliest electro-executions in the State.

Rockwell died, April 12, 1933.

S. R. RANGANATHAN.

SCIENCE NOTES AND NEWS

Discovery of Carved Heads in Mexico.—Five colossal heads carved in human form from basalt, each weighing 20 tons or more, have just been discovered in the Tehuantepec Isthmus region of Mexico by a joint archæological expedition of the *National Geographic Society* and the *Smithsonian Institution*. The expedition was headed by Matthew W. Stirling, Chief of the Bureau of American Ethnology of the Smithsonian Institution. So far, the expedition's excavations have failed to uncover any evidence to indicate the age of the gigantic carvings or what part they played in the religious life of their creators.

According to a Communique issued by the *National Geographic Society*, the heads were found near the small village of La Venta in the western edge of the State of Tabasco, about 20 miles from the coast of the Gulf of Mexico. They lay within an area about a quarter of a mile square, and all were almost completely covered by soil.

The newly found sculptures are similar to the single colossal head unearthed in 1939 by the same expedition at Tres Zapotes, Vera Cruz, a hundred and twenty miles to the west. This was the first of the mysterious big heads to be fully excavated and photographed. The existence of one partially buried head at La Venta had been reported in 1925 by a Tulane University expedition led by Frans Blom; but it was not suspected that five of the huge carvings existed until Mr. Stirling visited the site last month.

The five colossal heads of La Venta vary in height from 6 to 8 feet 5 inches, and in circumference from 13 feet 7½ inches to 21 feet 7 inches. It is estimated that the weight of the largest may exceed 25 tons. The archæologists have as yet found no source of basalt nearer

than 100 miles. Two of the unsolved problems in connection with the heads are, where they were made and how the huge, heavy pieces of stone were transported to their present sites in the swampy coastal plain.

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The American Rhinoceros.—A joint palæontological expedition of the *National Geographic Society* and the *South Dakota State School of Mines*, is now on the field in the Badlands of the Western South Dakota, seeking the remains of the queerest creatures—protoceras, titanothere and other New World types of rhinoceros—that roamed the plains of North America—some thirty millions of years ago. The Badlands area, once a grass covered region of rolling plains, has undergone, during all these ages, radical changes and is now covered with large quantities of eroded materials and volcanic ash. Erosion during the last 10,000 years and more, has exposed several bones and has disclosed the region to be a rich treasure-house for palæontological investigations. Many types of vertebrates have been "mined" there during the past three quarters of a century. But among them only a few complete skeletons of titanothere, protoceras and rhinoceros have been recovered. According to a communique from the *National Geographic Society* dated March 4, 1940, the expedition's chief aim will be to examine this region thoroughly; it is expected that the bones of many other animals will be found also.

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Jeremiah Horrox (1619-41).—A biographical note of interest has appeared in *Occasional Notes* for December 1939 (*Royal Astr. Soc.*, 1939, No. 7). This refers to Horrox, Curate of Hoole in Lancashire, who, to quote from the inscription on the monument erected in his honour in Westminster Abbey (1874), "in so short a life detected the long inequality in the mean motion of Jupiter and Saturn, discovered the orbit of the Moon to be an ellipse, determined the motion of the lunar apse, suggested the physical cause of its revolution and predicted from his own observations the Transit of Venus".

* * *

Retardation of Chemical Reactions.—Work on the retardation of oxidations in the liquid phase has been proceeding actively for the last twenty years, and yet unfortunately the worker who seeks an inhibitor for an oxidation not hitherto examined must still be guided almost entirely by trial and error. Kenneth C. Baily has now collected the most important data on liquid phase oxidations in 10 extensive tables (*Proc. Roy. Irish Academy*, 1939, **45 B**, 373) to which the worker may refer to discover what retarders have been tried in a given case, and with what results. Although the compilation of the tables has been an end in itself, an attempt has been made to draw some general conclusions, however limited they may be, in their applicability.

* * *

Essentials of Photomicrography.—A general account of the general principles of microscopy and photomicrography is given by Max Poser of the **Bausch and Lomb Optical Company**, Rochester (*Phototechnique*, Feb. 1940). Enormous amount of research has been done in recent years on various aspects of the construction and working of the microscope and the author presents these in a general manner and in nontechnical language. The differences between the various light sources are discussed and methods to eliminate glare are suggested. For this purpose the employment of an adequate light filter is advised by the author, the selection of the correct colour of the filter being easily determined by means of a small hand-spectroscope manufactured by the Bausch and Lomb Optical Co. The enormous advantage of ultra-violet light as source of illumination over ordinary types of light sources is discussed, especially for photomicrographic purposes. Practically twice the resolving power of a given numerical aperture can be achieved by using ultra-violet light of the cadmium line. This fact is bound to revolutionise future work. But it is essential that the entire optical system in this case, including the slides and coverglasses should be made of quartz, since glass is opaque for this short wavelength. The determination of the magnification of a photomicrograph is also explained. The paper is illustrated with excellent photomicrographs. Those, especially of the mitotic figures, are amongst the clearest ever published.

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Preservation of Wall Paintings.—A process consisting of what is called "application of a reverse humidity gradient", has been evolved by the Archæological Chemist with the Government of India, for preserving the celebrated wall paintings from Central Asia, now on exhibition in the Central Asian Antiquities Museum, New Delhi. The deterioration of these paintings has been traced to the presence of injurious salts in the materials originally employed. Variations of atmospheric humidity in the museum galleries causes the salts to go through a continuous cycle of solution and crystallisation, resulting in the decay of the plaster.

The process employed for restoring and preserving the panels consists in mounting them on the sides of a humidity chamber, with the painted surface exposed inwards to a relative humidity of over 85 per cent. Wet paper pulp is applied to the outer (plaster) surface of the panels. The layer of pulp, which removes the salts by absorption is removed when dry; the treatment is repeated, until the concentration of salts in the plaster is reduced to a negligible fraction. The paintings are then taken out of the chamber, the surface coated with vinyl acetate solution to strengthen the decayed surface and to fix the colours and finally the surface is pressed down carefully with hot iron.

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Fight against Soil Erosion in India.—We are gratified to note that energetic steps are being taken by the *Imperial Council of Agricultural Research* to fight the problem of soil erosion in this country which here, as in other parts of the world, has led to disastrous consequences of a permanent character to the cropping power of the land. Controlled grazing, contour trenching and bunding are among the methods that have been adopted in India to attack soil erosion

and some results of practical value are reported from various parts of the country, where the methods have been under trial for some considerable time. Recommendations have also been made for the formation of anti-erosion Provincial Boards and an All-India Anti-Erosion Committee to tackle the problem systematically and to bestow continuous attention to the subject. Among examples of successful attempts are mentioned certain experiments in the U.P. where the regulation of grazing resulted in a great improvement in the quality and quantity of fodder grasses and indigenous trees and shrubs, encouraging their natural rejuvination and effectively preventing soil erosion and the formation of ravines. It was also found that the cutting of grasses twice or thrice a year yielded much more than a single cutting at the end of the season, that closure to grazing alone resulted in increasing the yield of fodder grasses from three to fifteen maunds per acre and that grass samples from enclosed areas were greatly superior in quality to the grass from the ordinary hillsides. A notable example of large-scale contour trenching is that carried out in the Singbhum District of Bihar where a distance of 25 miles has been covered with encouraging results. Contour trenching combined with controlled grazing has resulted in striking increases in the yield of grass. These methods are also useful in mitigating the danger of floods, and the Governments of Bengal and Orissa are said to be looking to these methods as practical expedients. In Bombay much has been done by that Government for popularising the methods of constructing field bunds for preventing erosion and in the Punjab the Government has accepted a proposal for the grant of remissions of assessment as an inducement for the adoption of the practice by cultivators. A. K. Y.

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Jute Research in India.—(1) A somewhat surprisingly quick result following the establishment recently of the Jute Research Laboratory of the *Indian Central Jute Committee* is published in a press note issued by that Committee. It relates to the infection of the jute seed by Macrophomina (Rhizoctonia). It is now said to have been definitely established, that the infection is carried *within* the capsularia seed as well as on its surface. This source of infection was hitherto unknown in jute. The strain called D. 154 proved infected to the extent of between 12 and 15 per cent. and 4 to 6 per cent. of the seeds carried the infection within the seed, the balance being due to the infection of the outer surface of the seed-coat. The incidence of the disease in a crop of D. 154 on the Dacca Farm was found to amount to 20 per cent. of the plants. (2) The lines on which the Committee is working out an accurate method of forecasting the jute crop forms the subject of another press note and the random sampling method recommended by Prof. P. C. Mahalanobis for this purpose have won both approval and high commendation from the well-known American Economic Statistician, Prof. Harold Hotteling who examined and reported on the scheme. "No technique of random sampling", says Prof. Hotteling, "has so far, as I can find, been developed in the U.S.A. or elsewhere which can compare in accuracy or in economy with that described by Prof. Mahalanobis"—high praise which sets the seal upon a method which offers a practical solution to a knotty problem. (3) A third press note of the Committee draws attention to the decision arrived at during the last meeting of the Committee to conduct research on jute blended with flax. In view of the urgency of the flax question and the possibility of India capturing a share of the flax market, not only now but in perpetuity it has also been thought desirable to install machines as soon as possible for thoroughly testing such flax as may be grown in India in the season 1940–41. A. K. Y.

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Control of the Pyrilla Pest on Sugarcane.—An interesting contrivance by which the biological method of controlling this pest can be greatly enhanced in its effectiveness has been devised by the Biological Control Research Officer at the Palhera Farm near Meerut Cantonment (*Indian Farming*, March 1940). The device consists in enclosing egg masses of pyrilla, both parasitised and healthy, in small portable wooden cages with wire-gauze panels, the gauze having 90 meshes to the square inch, and then distributing these cages in different parts of the field. The mesh is found large enough to allow the parasites to fly out on emergence but too small for the exit of the pyrilla nymphs. It was observed that all parasites emerging from the parasitised eggs in the cage flew out into the field through the meshes of the gauze while hundreds of pyrilla nymphs emerging from healthy eggs were trapped in the cages and perished. The parasites were thus helped to tide over their numerical weakness and thereby to gain very materially in their power as a controlling agent. In the experiment reported the percentage of parasitised eggs in the field rose from 30 to well over 60 in the course of three weeks, as the result of the new contrivance. The method has also been found applicable to the parasites attacking pyrilla in the winter, which are different from those described above. A. K. Y.

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New Salt Find at Sambhar Lake.—Deposits of common salt have recently been found near the Sambhar Lake, and vast quantities of this material are now being scraped out in a form ready for the market. The area from which the salt is now being scraped out, has been functioning as the main bitterns-area for the surrounding kyars or collection of manufacturing pans. For years and years the refuse liquor (or bitterns) is being thrown away into this area.

Ordinarily, after the rains, this area remains covered with brine, but this year, owing to dificiency in rainfall, the whole of the deposit lay exposed and its exploration led to the discovery by Mr. Rahim Baksh, Superintendent in the Northern India Excise and Salt Department at Sambhar, of a regular layer of crystal salt of good quality about 3" in thickness, beneath 1"–2" thick crust of impure salt, which was easily removable from the top. On excavation by normal methods, the layer breaks up

easily into separate and well matured crystals, medium and large in size, and absolutely white in colour. Washed with condensed brine, the salt attains a purity which compares very favourably with the ordinary salt manufactured or mined in India, or imported from abroad, the percentage of sodium chloride varying between 95 and 99. Even in unwashed samples, the percentage is 92 to 97.

It is anticipated that in the edge of the area where crystal salt has been discovered, there is about 10,00,000 maunds of powdered salt.

* * *

The Comparative Strengths of Some Important Indian Timbers and their Uses.—The publication of the booklet by Mr. V. D. Limaye (*Indian Forest Records*, New Series, Utilisation, Vol. 1-A) is opportune just now when it is of urgent national importance to replace, with suitable substitutes, some of the conventional timbers hitherto imported in large quantities to Great Britain. Apart from durability and, of course cost, the strength factors of timbers constitute limiting factors in many forms of utilisation; and Mr. Limaye has presented here the strength data of about 36 common Indian timbers (and also of six commonly imported timbers) in a simple and vivid manner by adopting the method of "Stick diagrams" with the corresponding Teak value arbitrarily taken as 100. Short explanatory notes indicating the distribution of the species and the uses for which the timber is suitable add to the value of this publication which should be welcome to engineers and laymen alike as a sort of "Who's who?" in Indian timbers.

EMMENNAR.

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Handedness in Inheritance.—It has now come to be recognised that handedness is a quantitative and therefore a graded trait. No simple Mendelian explanation accounts for either right- or left-handedness but the more frequent occurrence of left-handedness as a familial trait is clearly noticeable. This phenomenon is discussed by D. C. Rife in a recent paper (*Genetics*, 1940, 25, No. 2). If one of the parents is left-handed, it is more likely that children are also left-handed than if both parents are right-handed. And if both parents are left-handed about 50 per cent. of the children are left-handed. In twins of both mono- and dizygotic kinds left-handedness occurs more commonly and frequently among twins one member is right-handed and the other left-handed. Even so, twins where one member is left-handed have a higher percentage of left-handed relatives than pairs composed only of right-handers. It is believed that handedness being a quantitative trait, many individuals are genotypically intermediate and may be influenced either way by environmental conditions. More left-handedness can be expected among the relatives of genotypically intermediate twins than among the relatives of genotypic right-handers.

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Toxicity of Lead Arsenate to a Leaf-feeding Insect.—Many insects feed upon a variety of host plants,—certain of which appear to be inferior to others as a diet. The effects of different diets of this type are often apparent in the rate of growth of the insects, the fecundity of the adults, the resistance to disease and even in the pigmentation of the individuals. These physiological variations have been noted from time to time, by Mr. M. C. Swingle of U.S. Department of Agriculture, in the case of the southern armyworm, *Prodenia eridania* Cram. (*J. Econ. Ent.*, 1939, 32.) It appeared possible, therefore, that other physiological changes may have occurred, which would result in a change in the resistance of the insect to certain insecticides. A short series of tests made by him definitely showed that the resistance of southern armyworms to lead arsenate could be controlled by previously feeding them with particular species of plants.

Further research in this direction is expected to considerably add to the knowledge of better utilization of insecticides in the control of harmful insects.

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Tellurium in Tin Alloys.—It was shown by Dr. Hanson and Dr. Pell-Walpole some time ago that a little tellurium improves the creep strength of pure tin, both in the rolled and the cast conditions. A convenient method of determining tellurium in these alloys has been worked out by Dr. Pell-Walpole. He ascertains the loss of weight that occurs on distillation *in vacuo* when tin telluride (TeSn) distils without dissociation. A note of the method forms Publication 96 of *The International Tin Research and Development Council.*

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The Inter-University Board has rendered valuable service to the cause of higher education in India by publishing the report of the Proceedings of the 15th Annual Meeting (1940). This body of educational experts have considered several outstanding problems in university education, and in many cases they have offered wise and practical solutions. They have set up, as it were, certain sign-posts in educational thought and administration, certain goals towards which effort may be directed. Thus, for instance, Dr. C. R. Reddy in his welcome address to the assembly, makes a powerful plea for harnessing the resources of Indian Universities towards practical ends in industry and commerce. He sees a great opportunity in the present war for doing this, since supplies of technical products from the advanced countries of Europe are now cut off.

Among other questions of general interest brought up at the Conference was the problem of separate courses of study for women candidates in Indian universities. This is an important matter regarding which certain universities have already made some headway; but the lead given by the Board in favour of this step is likely to strengthen the hands of these pioneers. Another valuable suggestion, supported by no less a scholar than Sir Jadunath Sarkar, aims at bringing about a closer association between historical research departments of Indian universities and the Imperial Record Department of the Government. That this is a very desirable move will be admitted by all students of Indian history. In recent years the contribution of Indian savants to our knowledge

of India's past has been steadily expanding; but this expansion can be greatly accelerated by affording improved facilities for research on the lines suggested in the proposal.

A matter of, perhaps, less general interest, but nonetheless an important matter from the point of view of educational administration, is the status of Cambridge School Certificate Examinations in relation to university studies in this country. Not only Anglo-Indians but many Indian boys and girls are now appearing for these examinations. It is therefore urgently necessary that there should be some uniformity of practice among Indian universities as to the treatment of these candidates.

Finally it may be observed that the already useful work of the Inter-University Board may be further enhanced by providing a conspectus of the arrangements existing in the various departments of Indian universities. A beginning has already been made in this direction in regard to certain faculties such as Education and Law. These studies may be extended to other faculties as well as brought up to date from time to time.

Such an effort will help to bring about greater uniformity in university arrangements. It is not suggested here, however, that absolute uniformity of practice throughout India is either practicable or even desirable. Nor has the Board any statutory authority for co-ordination, its resolutions being no more than mere recommendations. But still, there are certain matters in regard to which voluntary uniformity may be attained. For this purpose a knowledge of what is going on elsewhere is necessary. The Board may legitimately provide this knowledge. Perhaps the suggestion of Mr. N. S. Subba Rao, advocating more stable foundations for the Board, will be helpful in this connection.

D. S. GORDON.

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Research Institute, Ayurvedic and Unani, Tibbi College, Delhi.—The annual report of the Director for 1938–39, gives an account of the work on some of the drugs carried out by Director S. Siddiqui and his colleagues. *Ayurvedic* and *Unani* systems of medicine possess many valuable and efficient drugs still unknown to Western science, and this Research Institute has the commendable object of bringing them to the knowledge of the scientific world and placing the use of these drugs on a modern scientific basis, by investigating the nature of the active principles whose potency is responsible for the curative property of the drug. This is a long and arduous task, requiring patience, skill and technique of a high order. Director Siddiqui "has tackled these difficult problems energetically and has achieved results of great value to medical science."

It is noteworthy that many of his colleagues have obtained their doctorates from other Universities on the strength of their work at this Research Institute, which is just becoming a centre for work on drugs. We hope that this Institute will obtain greater and a more practical recognition. We wish to congratulate the Director on the excellent work carried out at the Institute.

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Indian Forest College, Dehra Dun.—The first annual report of the College (1938–39) just issued, emphasises the importance of training future forest officers in India, and invites attention to the special facilities existing for such training at Dehra Dun. Sixteen students representing different parts of India are undergoing training at the College. Central Provinces, Mysore, Travancore and other States are not represented at the College. The practice of forestry differs in different parts of the world, and a comparative study of these methods would be extremely valuable. Some of the best authorities on Forestry in England have had their rich and extensive experience in India and Burma. It would be to mutual advantage if a system of exchanges between the forest services in various parts of the Empire could be introduced.

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The Imperial Council of Agricultural Research has recently issued a valuable Bulletin on Chalcids (*Misc. Bull.*, No. 30), summarising all available information on the natural habitats of these parasites and the variety of hosts attacked by them. Nearly 200 parasites are dealt with and all information available about their distribution and life-histories is included. A host-parasite index is also given.

The Bulletin does not deal with all the parasites which actually occur in the country, as a large number of them, accumulated in the Laboratory of the Imperial Entomologist at the *Imperial Agricultural Research Institute*, New Delhi, have not yet been identified. A supplement to the Bulletin will be issued as the mass of unnamed parasites in the Imperial Pusa Collection is worked out.

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An Inventions Board for Canada.—An Inventions Board has been established by the Government of Canada to deal with the growing volume of inventions and suggestions intended to further Canada's war effort which are being received by the various departments of Government.

The establishment of the Inventions Board provides a means whereby ideas and inventions submitted by citizens of Canada and abroad can be carefully examined, and promising proposals cleared to the proper authorities.

Dean C. J. Mackenzie, Acting President of the *National Research Council*, is the Chairman of the Board and Mr. S. J. Cook, Officer-in-Charge, Research Plans and Publications Section, *National Research Council*, the Secretary. The other members are, Lt.-Col. K. S. Maclachlan, Col. H. Des Rosiers and Mr. W. R. Campbell.

All proposals received will be considered in the first instance by the Examining Committee. Those which offer promise will be reviewed by members of the Consulting Panel, and the proposals which meet with the approval of these two groups will then be considered by the Board.

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The next outburst of sunspots should occur early in 1944 and the next maximum of sunspots should come in the summer of 1948. Communicating this forecast in a letter to the

Editor of the *Physical Review*, of June 5, 1939, J. R. Stewart and F. C. Eggleton (Princeton Observatory) stated that since 1749 A.D. sixteen sunspot cycles have been completed. The seventeenth is not yet complete. The next one may be expected to commence roughly two-thirds of a year after the sunspot number has fallen to one-tenth its maximum value. This places the date early in 1944. The new forecast is made by fitting curves to the graphs made in plotting the number of sunspots monthly.—(*Bull. Amer. Met. Soc.*, 1940, 21, 117.)

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Weather Reports from America.—Two 2,000-ton Coast Guard cutters, with meteorologists of the *United States Weather Bureau* on board, have been ordered to permanent stations in the Atlantic, one one-third and one two-thirds of the way from Bermuda to the Azores. The equipment provided includes balloons carrying instruments for measuring pressure, temperature, and humidity, and the ships will report weather conditions direct to Washington. This step has become necessary in view of the scarcity of radio reports from ships at sea due to the present political situation in Europe. Because of the war, both belligerent and neutral vessels have silenced their radios, thus cutting down greatly the number of meteorological reports and rendering difficult the preparation of the usual weather maps of the north Pacific coast.

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The Health Organisation of the League of Nations.—At a meeting of the *Emergency Sub-Committee* held from March 4th to 10th, several medico-social questions arising out of the movements of civil populations were considered and a report dealing with (1) measures to be applied before transfer, (2) the action to be taken during the move and (3) the working of the welfare and medico-social assistance services in the reception areas, was adopted.

Among other questions considered at the meeting was one relating to the increase of cases of *cerebro-spinal meningitis* in several European countries. In recent years, the curve of incidence of cerebro-spinal meningitis in Europe and in the United States of America has displayed annual variations which themselves fluctuate in cycles of from 8 to 12 years. The last peak was reached in 1928–29. During the first two months of 1940, the seasonal increase in England, Switzerland, Germany, Austria, Hungary, Bulgaria and Yugoslavia, was greatly in excess of that normally recorded in those countries. It is characterised by the very wide dispersion of sporadic cases, the absence of epidemic foci and a decline of the fatality rate.

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Entomological Society of India (Bengal Branch).—Mr. D. D. Mukerji has been re-elected President of the Society for the year 1940–41 and Dr. D. P. Raichoudhuri, Secretary.

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University of Mysore.—The annual meeting of the Senate was held on the 1st March 1940. Among the propositions that were passed mention may be made of the following: (1) The adoption of Budget Estimates of the University for 1940–41. (2) Transitory Ordinance relating to the admission of passed S.S.L.C. candidates with an optional group selected from Group C or D to the Intermediate course in Arts. (3) Grant of exemption to students belonging to the depressed classes from payment of tuition fees and examination fees for a further period of 5 years, i.e., up to the end of academic year 1944–45. (4) Levy of fees for tuition on Mysorean women students in the Arts and Science Colleges at half the prescribed rates and of full fees for examinations. (5) Courses of studies and schemes of examination in Geography for the Intermediate and the B.A. and B.Sc. Degree Examinations. (6) Courses of study and scheme of examination in Hindi as an optional subject for the B.A. Degree Examination. (7) Addition of 'Urdu' to the list of major subjects which may be offered for the B.A. Honours Degree Examinations. (8) Amendment of Ordinance relating to the Master's Degree Examination permitting a thesis to be offered in lieu of all the four papers. (9) Division of the second examination in Engineering into two examinations. (10) Reduction of the minimum to be obtained for a pass in English at the Intermediate Examination from 40 per cent. to 35 per cent.

* * *

The Syndicate of the Calcutta University has recommended that Prof. Bidhubhushan Roy, D.Sc., may be reappointed *Khaira Professor of Physics* and that he may be permitted to serve in that capacity till he completes his sixtieth year.

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MAGNETIC NOTES

April 1940.—Magnetic activity during the month of April 1940 was much less than that during the previous month. There were 13 *quiet* days, 13 days of *small* disturbance and 4 of *moderate* disturbance as against 4 quiet days, 21 days of small disturbance, 3 of moderate disturbance and 2 of great disturbance during the month of April 1939.

The day of largest disturbance during the month was the 3rd and that of least disturbance the 10th. The magnetic character during individual days is given in the table below.

Quiet days	Disturbed days	
	Slight	Moderate
6–10, 16–19, 23, 27, 29, 30	2, 4, 5, 11, 12, 14, 15, 20–22, 24, 26, 28	1, 3, 13, 25

There was only one storm of moderate intensity during the month as against 4 storms (2 of moderate and 2 of great intensity) during April of last year.

The mean character figure for the month is 0·70 as against 1·03 for the same period of last year. M. R. RANGASWAMI.

SEISMOLOGICAL NOTES

During the month of April 1940, two slight and three moderate earthquake shocks were recorded by the Colaba Seismographs as against

Date	Intensity of the shock	Time of origin I.S.T.	Epicentral distance from Bombay	Co-ordinates of the epicentre (tentative)	Depth of focus	Remarks
1940		h. m.	miles		miles	
April 1	Moderate	16 49	4700	Near 2° S., 139° E., in the vicinity of New Guinea		
,, 6	Slight	19 13	2130	Near 27° N., 105° E., in South China		
,, 13	Slight	12 01	2230	Anatolia ?		
,, 16	Moderate	11 38	5630	Near 55° N., 178° E., in the Bering Sea		
,, 16	Moderate	12 13	5590	Probably the same as above		

three slight, one moderate and two great shocks recorded during the same month in 1939. Details for April 1940 are given in the above table.

ASTRONOMICAL NOTES

Planets during June 1940.—Both Mercury and Venus will be visible as evening stars during the month; the former reaches greatest eastern elongation (25° 18′) on the 24th, when it sets about an hour and a half after the Sun. Venus which is rapidly approaching the Sun will be at a stationary point of its orbit on June 4. It then begins to move in a retrograde direction and after reaching inferior conjunction with the Sun on the 26th, becomes a morning star at the end of the month. Mars is gradually getting fainter and is an inconspicuous object in the evening twilight.

Jupiter will be visible as a morning star rising about three hours before the Sun. Not far from it is Saturn which rises about a quarter of an hour later. The rings will be seen considerably widened since the time the planet was last observed in the evening sky. Uranus is slowly moving in the western border of the constellation Taurus, about six degrees to the south of the well-known cluster, Pleiades. There will be a close conjunction of the Moon with Saturn on the night of June 30.

The Milky Way.—Many of the interesting parts of the Milky Way can be conveniently observed in the early part of the night during the month. The regions in the constellations Cygnus and Aquila as well as the star clouds in Sagittarius are amazingly rich in faint stars, and will well repay a careful study. Between Cygnus and Scorpio the Milky Way divides itself into two narrow streams running parallel to each other. The obscure patches, the dark rifts and lanes that are found in the constellation Ophiuchus and other places also deserve special attention. These are regions apparently devoid of stars where occur large patches of obscuring clouds cutting off the light of the more distant stars in the background. These dark clouds are objects comparatively near our system at distances ranging from three hundred to two thousand light years. T. P. B.

ANNOUNCEMENTS

Changes in Nomenclature.—*Indian Farming* (March 1940) makes the important announcement that the improved varieties so far evolved at Pusa and others that may in future be bred at New Delhi will henceforth be known as Imperial Pusa varieties. This change has been made to keep up the earlier association of the Imperial Agricultural Research Institute with the word Pusa and at the same time to distinguish the strains bred by the Imperial Department of Agriculture from those which may be bred by the Bihar Agricultural Department at their station at Pusa. This nomenclature will also be adopted for the milch herd of the Institute as well as for herbarium specimens and specimens of insects, fungi, etc. A list of the old and new names of the varieties of improved varieties of crops under distribution is given, of which the following will serve as examples:—Of wheats, the old names Pusa 4, 12, 52, etc., are now changed to I.P. 4, 12, 52 respectively; of paddy, the old names Pusa Type 9, 18, 24, etc., are changed to I.P. 9, 18, 24 respectively; of linseed the old names Pusa Type 12, 121, 124, etc., are changed to I.P. 12, 121, 124 respectively and so on with the other crops.

The establishment of an International Collection of Cereal Varieties. for the study of the physiological races of rusts, has been suggested by Riehm (*Rev. App. Myc.*, 1940, **19**, 136). It has been pointed out that plant breeders require to know the reaction of cereal varieties to rusts (*Puccinia* spp.) not only in their own countries but also in neighbouring ones, where different physiologic races of the rusts may exist. Such information may safely be obtained only by field experiments in the countries concerned. The author has put forward proposals for international collaboration in such a project.

We acknowledge with thanks the receipt of the following:—

"Journal of Agricultural Research," Vol. 59, Nos. 10 and 11.
"Agricultural Gazette of New South Wales," Vol. 51, Pt. 4.
"Journal of Royal Society of Arts," Vol. 88, Nos. 4557 and 4558.
"Monthly Bulletin of Agricultural Science and Practice," Vol. 31, No. 3.
"Biochemical Journal," Vol. 34, No. 3.
"Journal of the Institute of Brewing," Vol. 46, No. 4.
"The Journal of Chemical Physics," Vol. 8, No. 3.
"Journal of the Indian Chemical Society," Vol. 17, Nos. 2 and 3.
"Comptes Rendus" (Doklady), Vol. 26, No. 5.
"Indian Forester," Vol. 46, No. 5.
"Transactions of the Faraday Society," Vol. 36, No. 228.
"Indian Farming," Vol. 1, Nos. 3 and 4.
"Genetics," Vol. 25, No. 2.
"Geological, Mining and Metallurgical Society of India," Vol. 10, Nos. 3 and 4.
"University of Illinois Bulletin," Vol. 37, Nos. 11, 12, 13 and 20.
"Journal of Nutrition," Vol. 19, No. 3.
"Proceedings of the Royal Irish Academy," Dublin, Vol. 45, No. 16 and Vol. 46, Nos. 1–3.
"Bulletin of the Health Organisation of the League of Nations," Vol. 8, No. 6.
"Chronicle of the Health Organisation," Vol. 2, No. 3.
"Transactions of the Mining, Geological and Metallurgical Institute of India," Vol. 35, Pt. 4.
"Review of Applied Mycology," Vol. 19, No. 3.
"The Mathematics Student," Vol. 7, No. 4.
"The Bulletin of the American Meteorological Society," Vol. 21, Nos. 2 and 3.
"Scripta Mathematica," Vol. 6, No. 3.
"Indian Medical Gazette," Vol. 75, No. 4.
"American Museum of Natural History," Vol. 45, No. 3.
"Nature," Vol. 145, Nos. 3673–76.
"Indian Journal of Physics," Vol. 13, No. 6.
"Canadian Journal of Research," Vol. 18, No. 3.
"Journal of Research" (National Bureau of Standards), Vol. 23, Nos. 2–4.
"Sky," Vol. 4, Nos. 5 and 6.
"Science and Culture," Vol. 5, No. 11.
"Indian Trade Journal," Vol. 137, Nos. 1767 and 1768.
"Indian Journal of Veterinary Science and Animal Husbandry," Vol. 10, Pt. 1.

ACADEMIES AND SOCIETIES

Indian Academy of Sciences:

April 1940. SECTION A.—H. J. BHABHA: *Classical theory of spinning particles.*—Dealing with a point dipole with no extension, it is shown that completely relativistic equations free from singularities can be found. R. H. SIDDIQUI: *Strychnine and Brucine—Part III. Some derivatives of dinitrostrychnic acid.*—Tafel's dinitro-strychnine hydrate has been proved to be dinitro-strychnic acid. MATA PRASAD AND K. V. MODAK: *Viscosity of stannic phosphate gels during setting.*—The viscosity changes in the gel-forming mixtures have been studied with time and the effects of temperature and of addition of non-electrolytes to these mixtures have also been studied. N. V. SUBBA RAO AND T. R. SESHADRI: *Some organo-mercury compounds derived from quinine and cinchonine.*—Mercuric chloride forms combinations with the basic nitrogen atoms of the alkaloids whereas with mercuric acetate it is possible to produce compounds by addition at the ethylenic double bond. K. GANAPATHI: *Chemotherapy of bacterial infections—Part II. Synthesis of some sulphanilamide derivatives and the relation of chemical constitution to chemotherapeutic action.*—2-N^1-Sulphanilamidothiazol appears to possess a very striking effect. Substitution of the amide part of the sulphanilamide especially by a heterocyclic ring, produces compounds of increased activity. N. A. SHASTRY: *On Angelescu's Polynomial* $\pi_n(x)$. H. L. DUBE AND S. PRAKASH: *Kinetics of Sol-Gel Transformation—Part III. The influence of temperature on the setting of some inorganic jellies.* H. L. DUBE: *Kinetics of Sol-Gel transformation—Part IV. The influence of purity of the sol on the setting of ferric arsenate and ferric phosphate jellies.* H. J. BHABHA: *On elementary heavy particles with any integral charge.*—The heavy elementary particles can exist in states of all integral charges, positive, negative or zero, the different states having different rest masses. P. V. KRISHNA IYER: *The analysis of asymmetrical experiments with special reference to the partition of treatment sum of squares.* F. C. AULUCK: *On some theorems of Ramanujam.*

April 1940. SECTION B.—B. N. SINGH AND M. B. LAL: *Studies in the Analysis of Fertiliser Effects—II. Photosynthetic Efficiency of* Saccharum officinarum *leaves as Influenced by Certain Manurial Treatments.* C. SRIKANTIA, P. R. SUBBA RAO AND T. PRASANNASIMHA ROW: *Glutathion in Ocular Diseases.* S. SINHA: *On the Characters of* Choanephora cucurbitarum *Thaxter on Chillies* (Capsicum *spp.*). S. SINHA: *A Wet Rot of Leaves of* Colocasia antiquorum *due to Secondary Infection by* Choanephora cucurbitarum *Thaxter and* Choanephora trispora *Thaxter sp.* (= Blakeslea trispora *Thaxter*).

Indian Chemical Society:

February 1940.—H. K. SEN: *Economics of coal carbonisation.* N. L. VIDYARTHY AND M. VENKATESH MALLYA: *Component glycerides of vegetable fatty oils—Part I. Niger seed oil.* S. V. PUNTAMBEKAR AND S. KRISHNA: *The fatty oil from the seeds of* Bauhinia variegata, *Linn.* SURESH CHANDRA SEN-GUPTA: *Studies in dehydrogenation—Part V.* P. C. GUHA AND G. D. HAZRA: *Synthetical investigations in the camphane series—Part V. Synthesis of ethyl* Bicyclo-(1 : 2 : 2)-*heptanedione dicarboxylate from ethyl* cyclopentanone-2 : 5-*dicarboxylate.* N. M. BASU AND M. C. MITRA: *On the osmotic relationships between egg-white and egg-yolk and the effects of injection of potassium cyanide and sodium fluoride thereon.* H. CHAUDHURI, N. N. CHOPRA, MANSA RAM AND J. N. RAY: *Biochemistry of* Aerobacter aerogenes *and* Bacillus cereus. S. S. BHATNAGAR, BRAHM PRAKASH AND JARNAIL SINGH: *Magnetism and Catalysis—Part I. Catalytic decomposition of potassium chlorate by manganese dioxide and ferric oxide.* S. S. BHATNAGAR, BRAHM PRAKASH AND JARNAIL SINGH: *Magnetism and Catalysis—Part II. Catalysis of persulphate and iodide reaction by ferrous ions.* R. KAUSHAL: *Pyrones and related compounds—Part I. Formation and structure of* 2 : 6-*dihydroxy*-1 : 4-*pyrone.*

March 1940.—RAFAT HUSAIN SIDDIQUI AND SALAH-UD-DIN: *Studies in the Naphthalene Series —Part I. Some Reactions of the* CH_2 *CO-Group.* RAFAT HUSAIN SIDDIQUI: *Studies in the Naphthalene Series—Part II. Synthesis of* 1-*Keto*-6-*bromo* (*or chloro*)-7 : 8-*dimethoxy*-1 : 2 : 3 : 4-*tetrahydronaphthalene.* RAFAT HUSAIN SIDDIQUI: *Strychnine and Brucine—Part IV. A Note on* iso-*Strychnic Acid.* NRIPENDRA NATH CHATTERJEE AND GIRINDRA NATH BARPUJARI: *Experiments on the Synthesis of Keto-acids. Synthesis of* 2-p-*Methoxyphenylcyclopentanone*-3-*carboxylic Acid.* NRIPENDRA NATH CHATTERJEE, BASANTA KUMAR DAS AND GIRINDRA NATH BARPUJARI: *Experiments on Synthesis of Keto-acids. Action of Sodium Ethoxide on Diethyl* cyclopentanone-2-*carboxylate*-2-*acetate.* R. R. BAHL AND SURJIT SINGH: *The Action of Chlorine on the Hydroxides of Lithium and Potassium in the Presence of Iodine—Part I.* BALWANT SINGH AND AHSANULHAQUE REHMANN: *Potentiometric Studies in Oxidation-reduction Reactions—Part VIII. Oxidation with Chloramine-T.* BALWANT SINGH AND AHSANULHAQUE REHMANN: *Potentiometric Studies in Oxidation-reduction Reactions. Part IX. Oxidation with Chloramine-T.* (Indirect quantitative determination). S. S. BHATNAGAR, P. L. KAPUR AND (MISS) GURBAKSH KAUR: *Magnetic Study of the Polymerisation of Styrene.* SURESH CHANDRA SEN-GUPTA: *Studies in Dehydrogenation—Part VI.* MUHAMMAD QUDRAT-I-KHUDA, SUBASH KUMAR GHOSH AND ASUTOSH MUKHERJEE: *The Chemistry of Oleo Margosa from* Melia Azadirachta *or Neem Oil—Part I. Isolation of the Constituents of the Oil.* R. C. HOON AND C. L. DHAWAN: *Electrodialysis of Soils. The Influence of Exchangeable Bases on the Recovery of Manganese by Electrodialysis.* AMRITANSU SEKHAR CHAKRAVARTI: *On the Molar Zero Fluidity Volumes of Some Organic Compounds.*

Meteorological Office Colloquium, Poona:

April 5, 1940.—J. M. SIL: *Schonland's Work on Lightning.*

Entomological Society of India (Bengal Branch):

April 10, 1940.—C. C. GHOSH: *Study of and Work on Entomology in Bengal.*—A general review of the growth of entomology in India. Special stress is laid upon the study of insects under natural conditions, specially of those insects that are of economic importance.

ERRATUM

Vol. 9, No. 3, March 1940:—

Contribution entitled "Asynapsis in Chilli (*Capsicum annuum* L.)", p. 126, para 1, first line: *For* "meotic" *read* "meiotic"; fifth line: *For* "such as" *read* "in". Para 2, line 9: *For* "(Fig. 1)" *read* "(Fig. 2)"; line 11: *For* "(Fig. 2)" *read* "(Fig. 1)". P. 127: It must be noted that Figs. 6, 7 and 8 are reduced to 4/5 and Fig. 9 to ½ the original; p. 128: at the bottom of the note *for* "Imperial *Agriculture* Research" *read* "Imperial *Agricultural* Research".